

SPECIAL FEATURES

This microcard deals with the ABS in the

* RENAULT 25 (3.1985→)

The ABS for this vehicle operates with 4 wheel-speed sensors and 4 hydraulic ducts.

STRUCTURE OF MICROFICHE

1. Read from left to right.

2. Title of microfiche (appears on each coordinate).

E16	Products/components/test step	
	Coordinate	

3. Limits of section

Beginning	Mid-section	End	One-page section

A01				
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A02				
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TEST SPECIFICATIONS

For reasons of safety test the ABS only with the ABS tester. The rapid diagnosis chart contains all important test specifications as well as information on testing and trouble-shooting.

TEST REQUIREMENTS FOR TEST WITH ABS 2 LED TESTER

- * Regulatory tire size fitted?
- * Check for firm seating and corrosion of ground for return supply pump and over-voltage protection relay term.31b (3) .
- * Check for leaks in hydraulic connections and sealing points at hydraulic modulator (visual examination).
- * If ABS warning lamp lights up intermittently when driving (e.g. after switching on consuming devices) and goes out again by itself, check battery and voltage supply (generator, regulator and voltage drops).
- * If ABS warning lamp lights up continuously and does not go out, check following points:
 - Controller plug sitting correctly on controller and latched?
 - All plug contacts O.K.?
 - Spring contacts latched?
 - Check installation position of seal ring in controller plug with respect to correct seating: rounded side facing downward.

- Check for correct assignment of wheel-speed sensor leads to controller plug.
Wheel-speed sensor
 - front left to term.5 and term.4
 - front right to term.11 and term.21
 - rear left to term.7 and term.9

- V-belt snapped?
(Generator provides no voltage, charge indicator lamp and ABS warning lamp light up).
- * For checking, switch on ignition for all program-selector-switch positions (tester operates with current supply from vehicle battery).
- * Observe LED (green) for current supply in all program-selector-switch positions.
- * Connect ABS 2 LED tester at ABS wiring harness.

C A U T I O N !

Disconnect and connect controller only with ignition off.

Do not run with tester connected!

Repeat the complete test program after each repair.

The Antiskid System is a vehicle safety system.

Work on this system demands detailed knowledge of the system.

The conventional brake system must be O.K.

General information for trouble-shooting

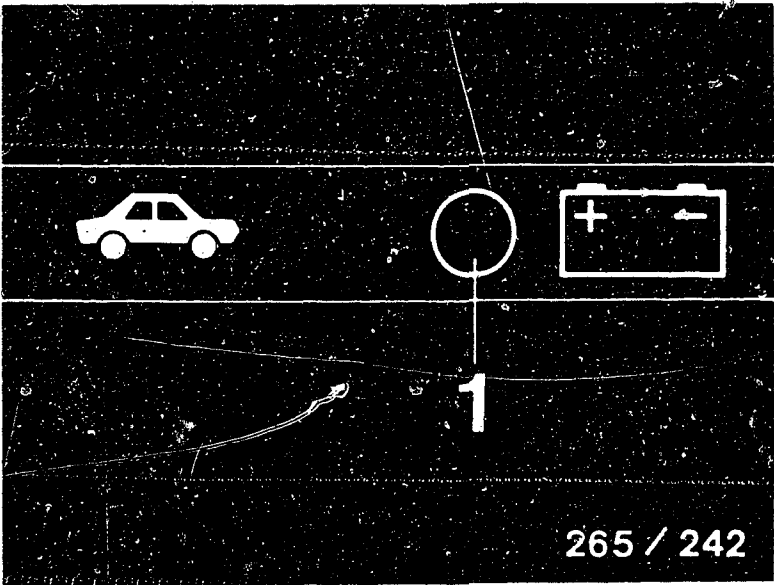
Check all leads for short circuit to ground and contact with positive lines and watch out for rubbed and pinched locations.

RAPID DIAGNOSIS CHART FOR ABS 2 LED TESTER

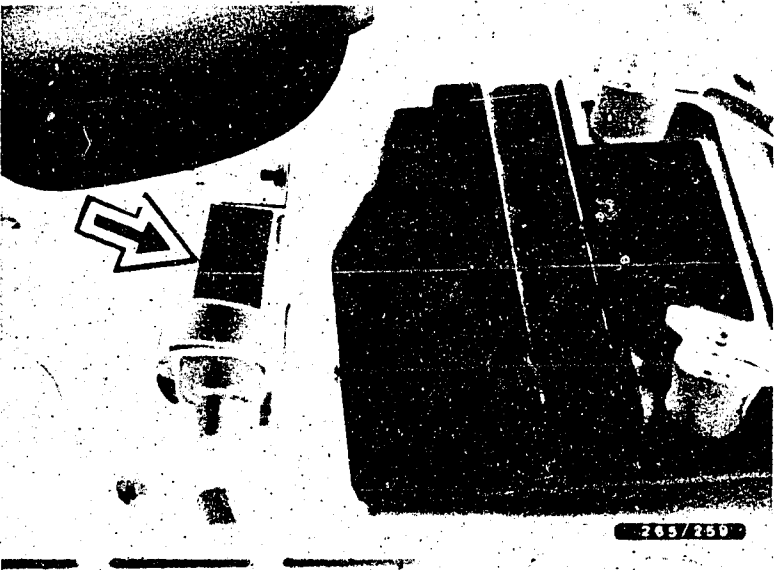
Do not drive with tester connected!

Program-selector-switch position 1 to 6

Under test (measurement at terminals)	Additional operation	Test specif- ication (reading)	Possible causes of trouble (see coordinate)
Voltage supply term. 1 and term. 20)	Ignition on	LED 1 (upper illustration) lights up constantly	<ul style="list-style-type: none">* 4-pin plug-in connection defective (C01)* Battery insufficiently charged* Voltage drops too high (C01)* Overvoltage-protection relay defective (C01)* Check lead to driving switch term. 15



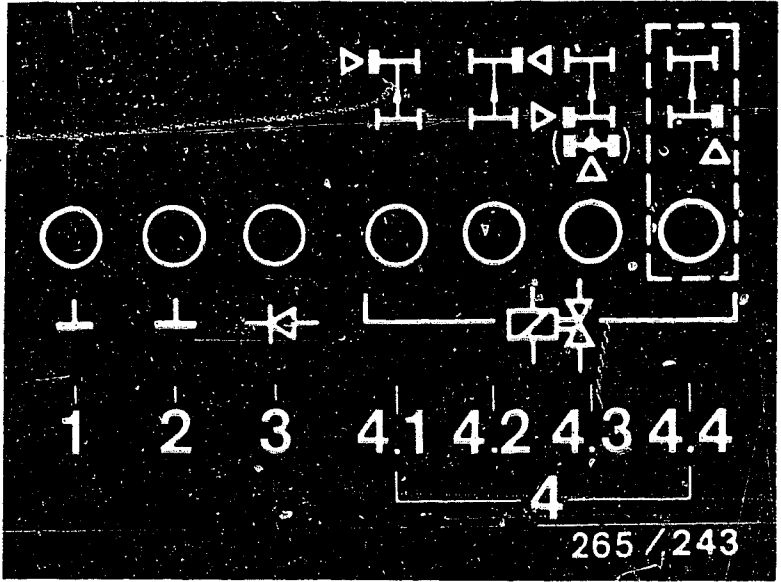
Arrow = Over-voltage
protection relay



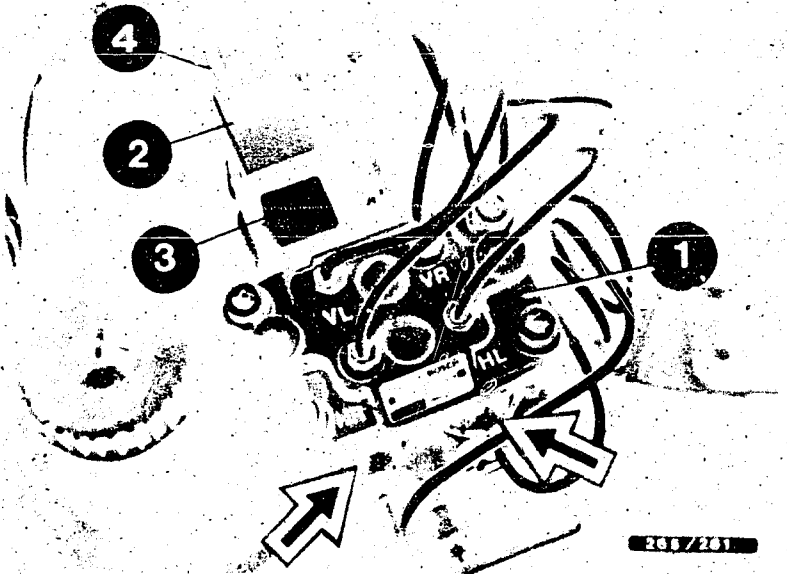
Rapid diagnosis chart (Continued 1)

Program-selector-switch position 1 (4-duct hydraulic modulator)

Test on (measurement at terminals)	Addit- ional operation	Test specification (reading)	Possible causes of trouble (see coordinate)
Ground (term.10, term.34) Diode for warning lamp (term.29, term.32) Solenoid-operated valve internal resistances (term.2, term.18, term.19, term.35) Off-position and ground of valve relay ABS warning lamp	Ignition on	7 LEDs (1 to 4.4) light up equal- ly brightly (upper ill.) ABS warning lamp in vehicle must light up	<ul style="list-style-type: none">* LED 1 and / or 2 (upper illustration) do not light up: Check ground terminals for short circuit. (C05)* LED 3 (upper illustration) does not light up: diode defective, check ground of valve relay. (C07)* One or more LED 4 do not light up: Check corresponding plug connection for solenoid-operated valve and leads. (C06)Solenoid-operated valve, internal resistance 0,7...1,7 Ω* All LED 4 and LED 3 do not light up: Check ground of valve relay, valve relay defective. (C09)* Weak lighting of a LED means contact resistance in corresponding current path. (C09)* ABS warning lamp does not light up: warning lamp defective. Note: all other 7 LEDs light up (B01)



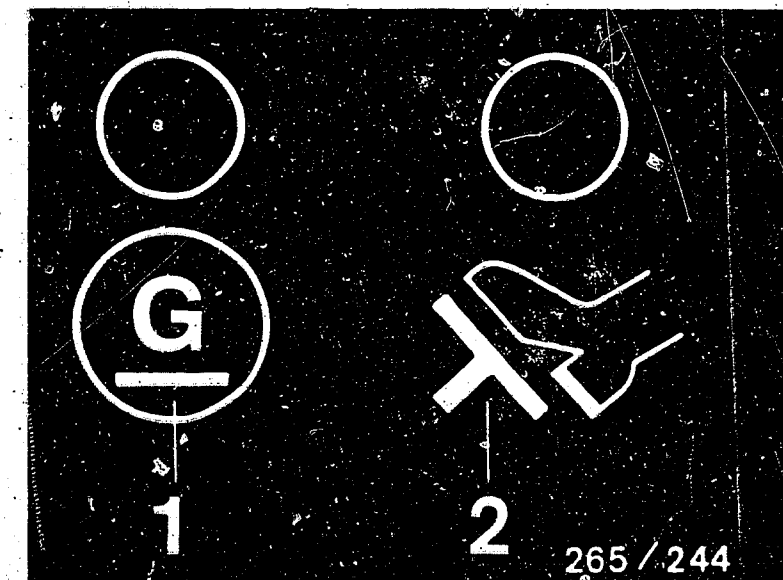
- 1 = Hydraulic modulator
- 2 = Motor relay
- 3 = Valve relay
- 4 = Ground cable
- Arrows = Sealing points



Rapid diagnosis chart (Continued 2)

Program-selector-switch position 2

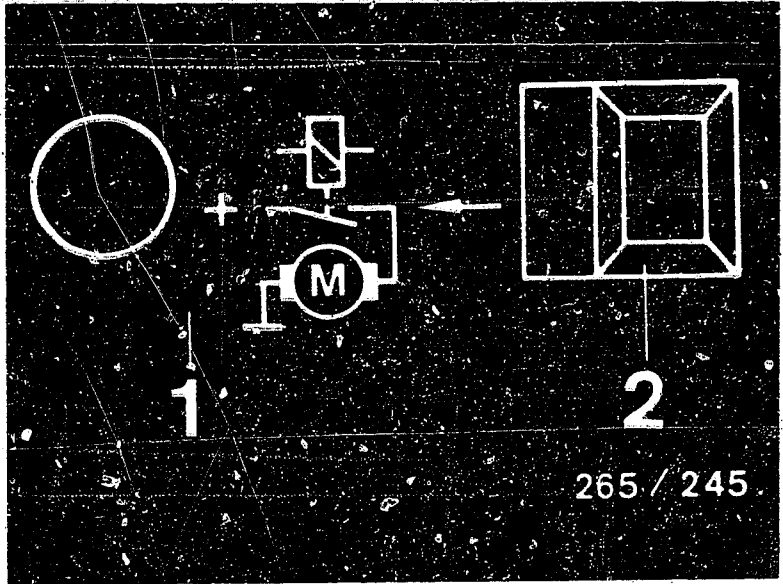
Test on (measurement at terminals)	Addit- ional operation	Test specification (reading)	Possible causes of trouble (see coordinate)
Voltage from oil- pressure switch (term.15)	Ignition on	LED 1 (upper illustration) lights up	* LED sometimes goes out only after snap acceleration (test is then O.K.) (C17)
	Start engine	LED 1 (upper illustration) goes out with engine running	* Check line to oil-pressure switch. * Oil-pressure switch defective. * 4-pin plug connection defective.
Stop-lamp switch (term.25)	Ignition on	LED 2 (upper illustration) lights up	* Stop-lamp switch defective. (C19) * Check lead to stop-lamp switch.
	Actuate brake pedal	LED 2 (upper illustration) goes out	* Lead at stop-lamp switch in- correctly connected. * 4-pin plug connection defective.



Rapid diagnosis chart (Continued 3)

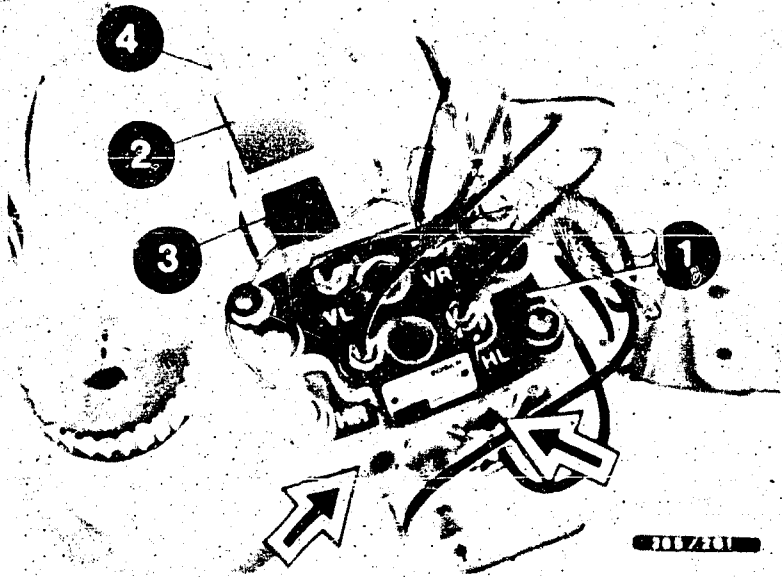
Program-selector-switch position 3

Test on (measurement at terminals)	Additional operation	Test specifications (reading)	Possible causes of trouble (see coordinate)
Motor relay, pump motor in hydraulic modulator (term.28 and term.14)	Ignition on, constantly press push- button 2 (upper ill- ustration)	LED 1 lights up, pump motor runs. After releasing push-button, LED stays lit due to run-on of motor (upper illustration).	<ul style="list-style-type: none">* Motor relay defective (C21)* Check ground and positive terminal of hydraulic modulator (C23)* Check leads from controller term.14 and term.28 to hydraulic modulator term.9 or term.11. (C23)* Pump motor defective (C23)



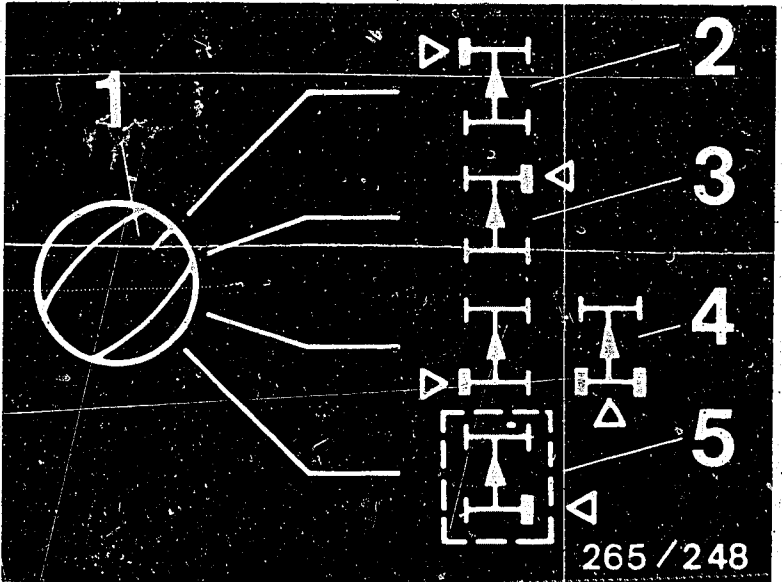
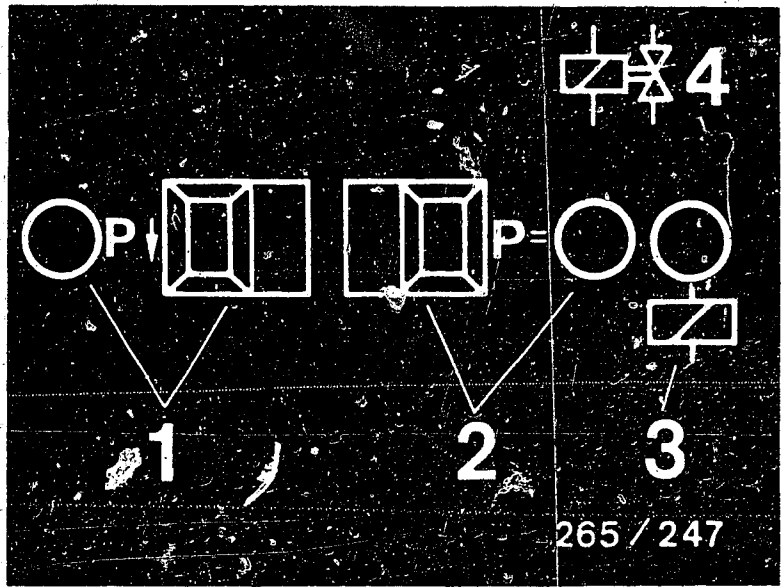
Program-selector-switch position 4 not applicable

- 1 = Hydraulic modulator
- 2 = Motor relay
- 3 = Valve relay
- 4 = Ground cable
- Arrows = Sealing points



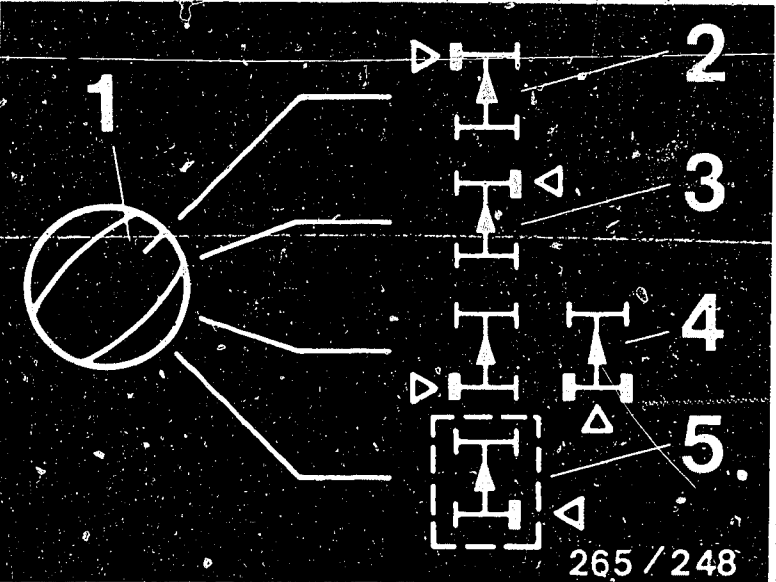
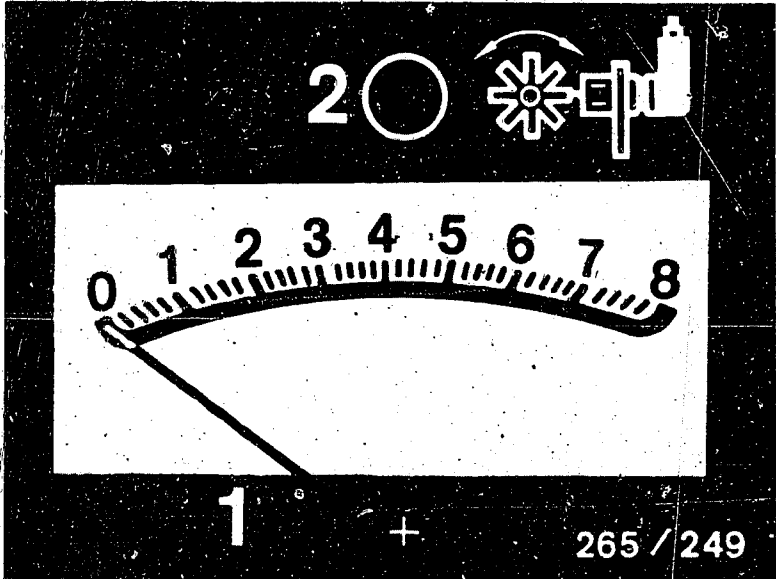
RAPID DIAGNOSIS CHART (CONTINUED 4)
 Program-selector-switch position 5 (4-channel hydraulic modulator)

Test on (measurement at terminals)	Additional operation	Test specification (reading)	Possible causes of trouble (see coordinate)
Valve relay op. (term.27)	Ignition on	LED 3 (upper illustration) lights up	*Valve relay (winding) or leads defective (D03)
Solenoid-operated valves in hydraulic mod. for function and mix-up. NOTE: Check each wheel separately in turn. Keep to operating sequence!	Chock up vehicle. Ignition on. The wheel being tested must be freely turnable by hand. Set switch 1 for wheel selection to wheel to be tested. (Lower ill.)		* Repeat test with engine running * Valve relay (make contact) defective (D03) * Brake in line from valve relay term.87 to B+ (D03) * Brake leads at hydraulic modulator mixed up (D07)
Operation pressure holding	1. Constantly press push-btn P= (upper ill.)	LED P= (upper ill.) lights up	* Current value not obtained (LED P arrow or P= goes out; upper illustration): Battery insufficiently charged. Repeat test with engine running. (D05)
	2. Constantly press brake pedal	Wheel turnable by hand	
	3. Release push- button P= (upper ill.)	LED P= goes out (upper ill.) Wheel locks	
Operation pressure reduction	4. Press push- button P arrow (upper illustration)	LED P arrow (upper ill.) lights up, wheel turnable by hand	* Solenoid-op. valves correct- ly connected electrically? Wheel, front left:term.2 Wheel, front right:term.35 Wheel, rear left:term.18 Wheel, rear right:term.19 Rear axle:term.— (D07) * Hydraulic modulator defective (D09)
	5. Release push- button P arrow (upper ill.)	LED P arrow (upper ill.) goes out, wheel locks	
	6. Release brake pedal		

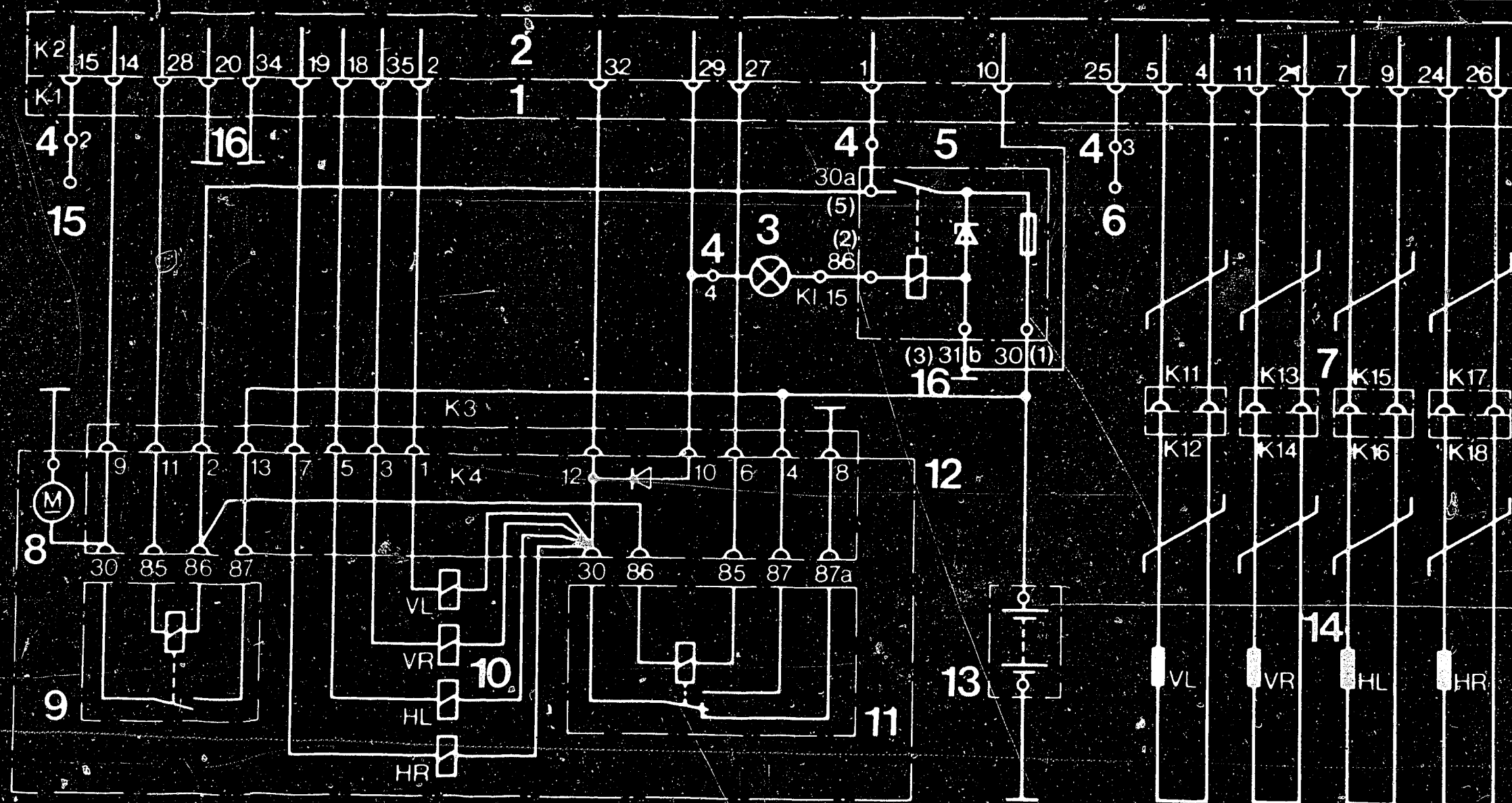


Program-selector-switch position 6 (4 wheel-speed sensor)

Test on (measurement at terminals)	Additional operation	Test specification (reading)	Possible causes of trouble (see coordinate)
Wheel-speed sensor for operation and mix-up NOTE: Check each wheel separately in turn. (Wheel, front left: term.4 + term.5 Wheel, front right: term.11 + term.21 Wheel, rear left: term.7 + term.9 Wheel, rear right: term.24 + term.26	Chock up vehicle. Ignition on. The wheel being tested must be freely turnable by hand. When testing the driven axle, the wheel not being tested must be locked. Set switch for wheel selection to wheel to be tested (lower illustration) Turn wheel by hand until LED 2 above instrument lights up without flickering. (Speed approx. 1 revolution per second). Afterwards read off reading at instrument: (upper illustration)	1.Smallest reading larger 1,6 divisions 2.Permissible fluctuation max. 25 % of greatest reading.	*Wheel-speed sensor lead mixed up (D15) *Break in wheel-speed sensor lead (D17) *Wheel-speed sensor defective (D17) Winding resistance front axle: 0,6...1,6 k Ω rear axle: 0,6...1,6 k Ω *Air gap between wheel-speed sensor and ring gear too wide (D19) *Ring gear defective or loose (D19) *Ring gear with incorrect number of teeth installed: Front axle: (48) teeth Rear axle: (48) teeth (D19) *Wheel-bearing clearance too large



Take for road test for final check. The warning lamp must go out when the engine is running. Drive at at least 30 km/h. The warning lamp must not light up again!



265/261

ELECTRICAL TERMINAL DIAGRAM

- 1 = Controller plug (35-pin)
- 2 = Controller
- 3 = ABS warning lamp
- 4 = 4-pin plug
- 5 = Over-voltage protection relay
- 6 = to stop-lamp switch
- 7 = Multiple butt connector
- 8 = Return supply pump motor
- 9 = Motor relay
- 10 = Solenoid-operated valves
- 11 = Valve relay
- 12 = Hydraulic modulator

- 13 = Battery
- 14 = Wheel-speed sensor
- 15 = Oil-pressure switch
- 16 = Ground terminal next to right headlamp

- VL = front left
- VR = front right
- HA = Rear axle
- HL = rear left
- HR = rear right
- K1 to K18 = ABS plug connections

TEST EQUIPMENT AND TOOLS

Designation	Code	Part number
ABS2 LED tester	KDAS 0003	Procure. address: Robert Bosch GmbH KH/VKD 3 Postfach 41 09 60 7500 Karlsruhe 41
Adapter lead (included in scope of delivery of tester)	KDAS 0003/2	
Charging and bleeding device		e.g. ATE Part No. 3.9302-1000.4 1)
Bleeder fitting for connection of charging and bleeding device to fluid reservoir of brake master cylinder		ATE Part No. 3.9302.0702.2 1)
Bleeder hose		ATE Part No. 3.3590.2300.1 2)
Auxiliary hose		ATE Part No. 3.9302.0704.2 1)
Brake-pedal-actuating device		ATE Part No. 3.9312.0100.4 1)

1) = obtainable from: Alfred Teves GmbH,
Guerickestr. 7
D-6000 Frankfurt (Main)

Test equipment and tools (continued)

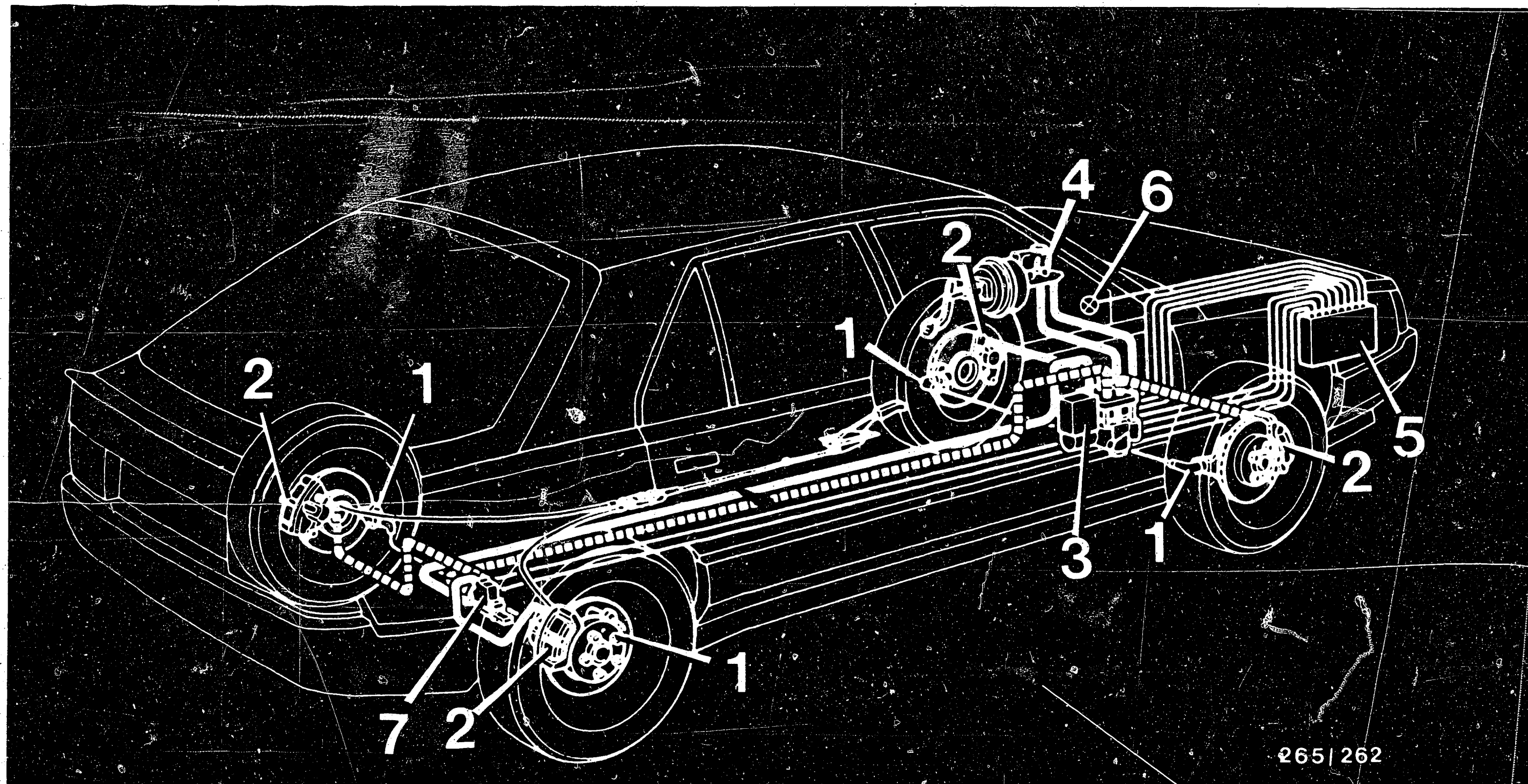
Designation	Code	Part number
Pressure tester Tester for checking low- pressure and high- pressure at hydraulic brake systems		e.g., ATE Part No. 3.9305-0200.4 1)
Flat double-end flare nut wrench, 9 x 11 mm		Hazet Part No. 612 2)
Container, approx. 1l for catching the brake fluid		
Brake fluid Use only DOT 4 or brake fluid from the vehicle manu- facturer.		
Electrics tester or multimeter for trouble- shooting	ETE 014.00	0 684 101 400 commercially available

Aids!
Use only original brake lines from the vehicle manu-
facturer!

Grease for wheel-speed sensor	Molykote Longterm 2
Protective caps for brake lines	1 900 508 002 (100 pieces)
Protective caps for brake-line connections at hydraulic modulator	1 900 508 004 (100 pieces)

1) obtainable from: Alfred Teves GmbH Guerickestr. 7
D-6000 Frankfurt (Main)

2) obtainable from: Hazet Co, D-5630 Remscheid

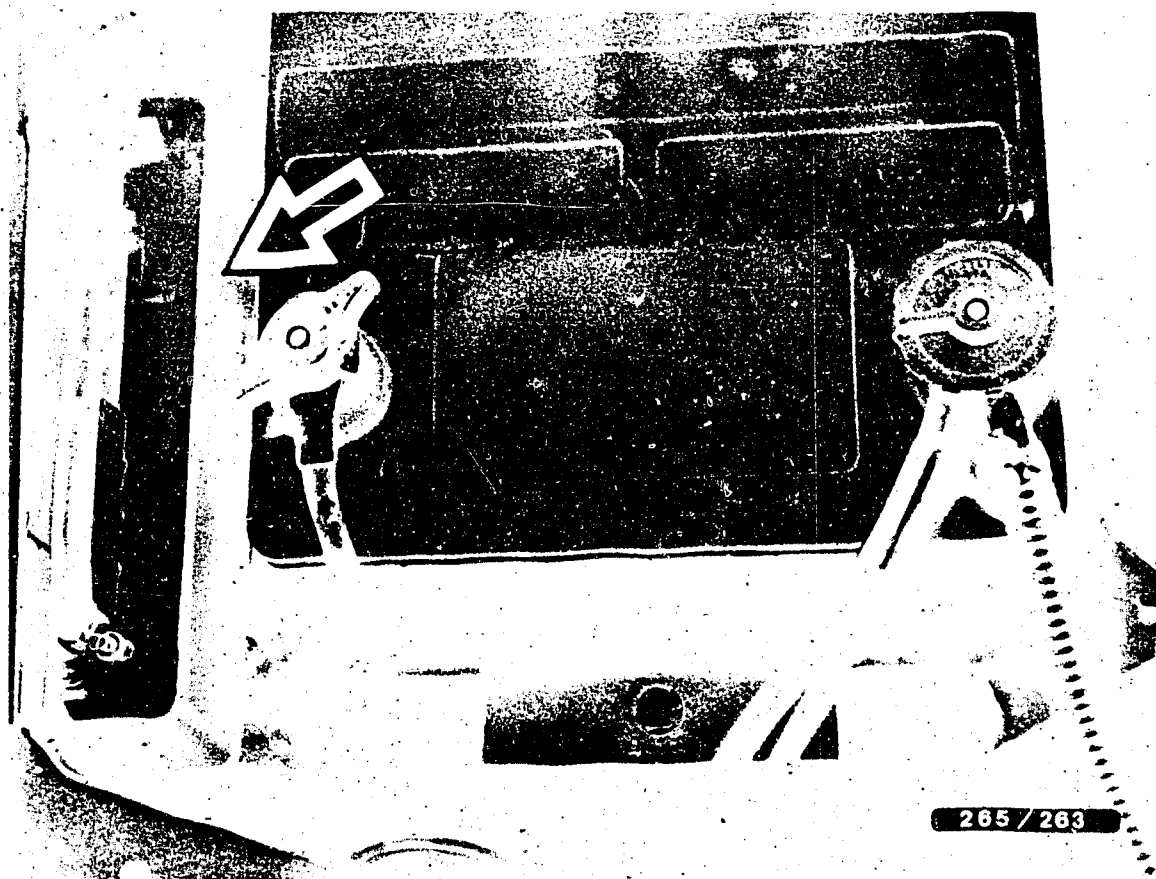


265/262

INSTALLATION POSITION OF COMPONENTS

- 1 = Wheel-speed sensor (4x)
- 2 = Disc-brake caliper (4x)
- 3 = Hydraulic modulator
- 4 = Brake master cylinder

- 5 = ABS controller
- 6 = Warning lamp
- 7 = Braking-force limiter



Installation position of components

Details of the installation position are always with reference to the forward direction of travel.

Arrow = ABS controller:

In engine compartment at right next to battery under a protective cover.

Remove battery to remove controller.

Over-voltage protection relay:

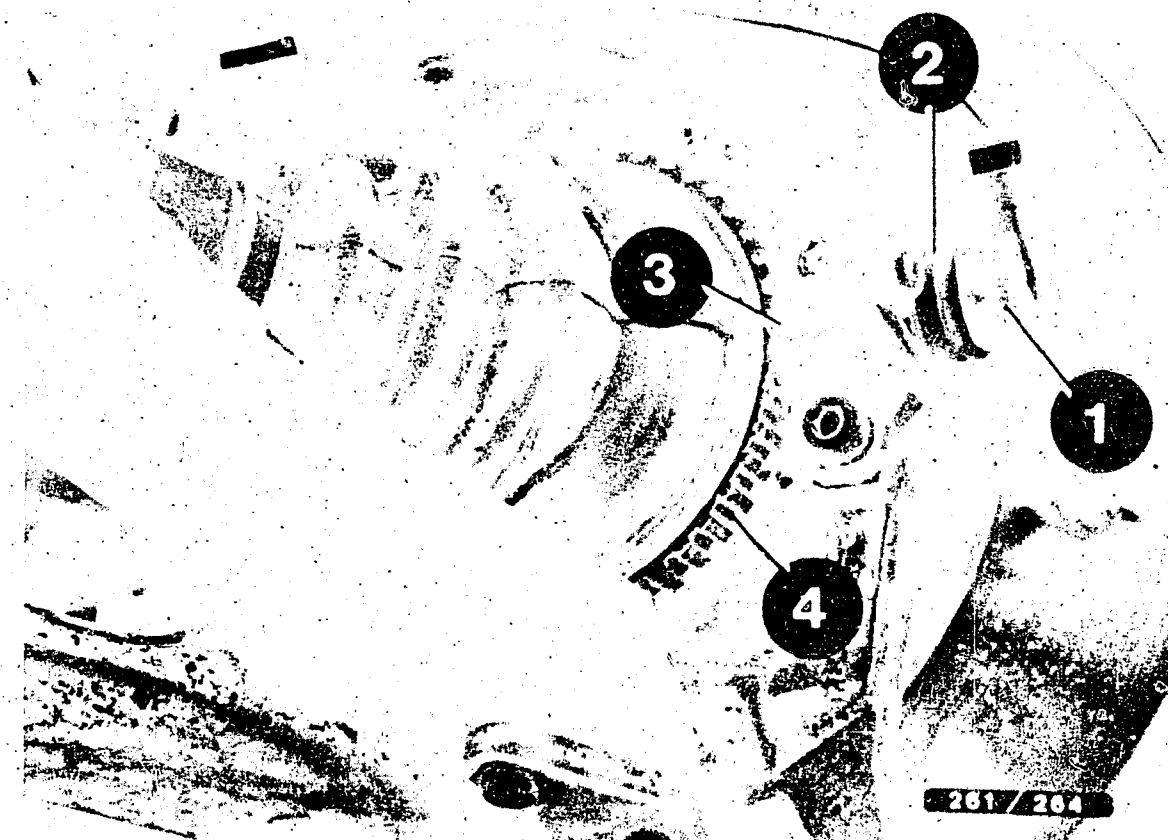
In engine compartment behind battery and under expansion tank.

ABS warning lamp:

In instrument panel.

ABS ground terminals:

Next to right headlamp and at hydraulic modulator.



1 = Wheel-speed sensor, front right

When removing, do not unscrew bracket (3)!

2 = Fastening screw

4 = Ring gear

* Wheel-speed sensors, front axle:

One at each side opposite the disc-brake caliper.

Plug connections beneath vehicle, left and right, on frame.

* Wheel-speed sensors, rear axle:

One at each side opposite the disc-brake caliper.

Plug connection for left-hand wheel-speed sensor beneath vehicle, left of spare wheel.

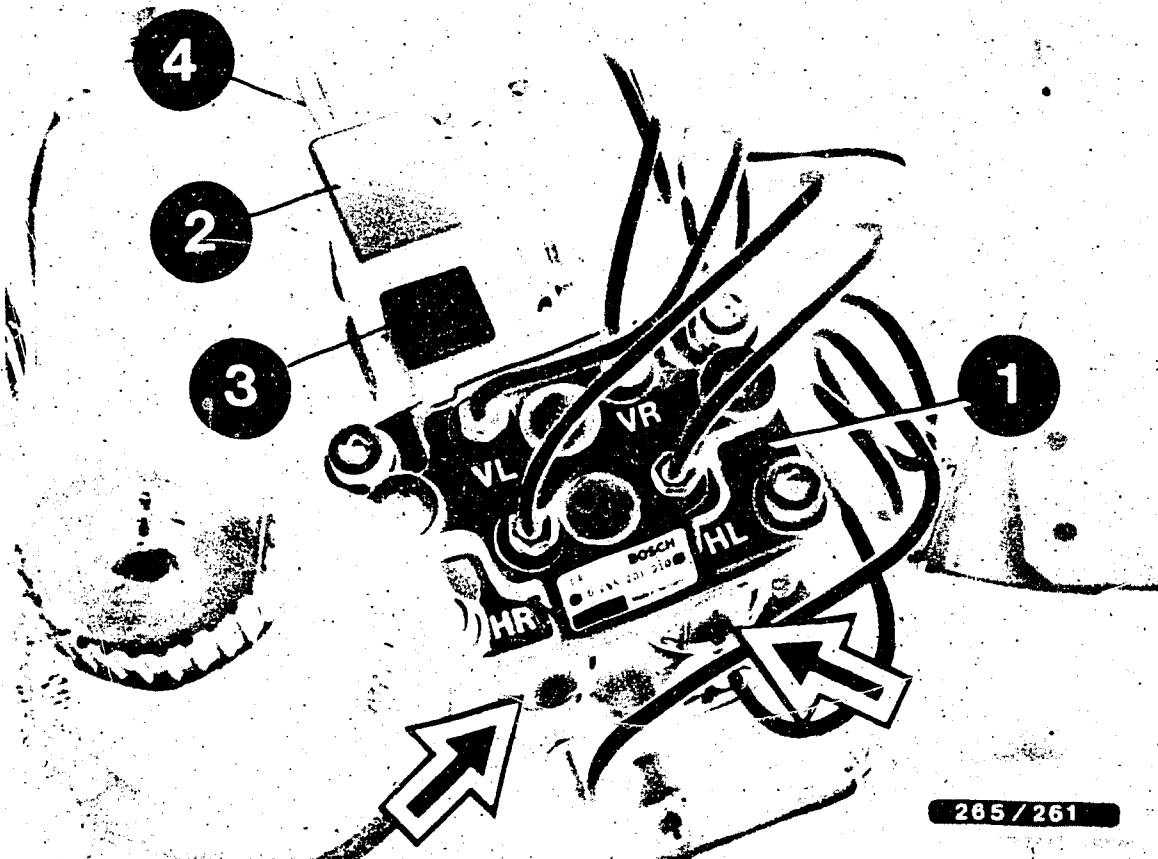
Plug connection for right-hand wheel-speed sensor beneath door sill, at rear on right next to fuel pump.

Both wheel-speed sensor leads are fed into the engine compartment beneath vehicle on the right-hand side.

GENERAL INFORMATION FOR REPAIRS AND ON BRAKE SYSTEM

The ABS is basically maintenance-free, however, when working on vehicles with ABS system the following must be noted:

1. When welding with electric welding equipment, pull plug from electronic controller.
2. When painting, the electronic controller may be loaded for a short time with max. +95°C and for a long time (approx. 2 hours) with max. +85°C.
3. After exchange of hydraulic modulator, controller, wheel-speed sensor and wiring harness, as well as after work in which the ABS units are touched (e.g. accident repairs), check the complete ABS system with the tester.
Pay attention to correct assignment of brake lines and wheel-speed sensor connections to controller as well as wheel-speed sensor plug connections (see vehicle-specific terminal diagram).
4. Each time after working on the brake system, the latter must be bled and go through low-pressure and high-pressure tests. Test all junctions for leaks.
5. Tighten battery terminals securely to terminal posts of battery.
6. Do not use a fast charger for starting the engine.
7. Never disconnect the battery from the vehicle electrical system when engine is running.



1 = Hydraulic modulator:

In engine compartment, in front of firewall

VL = Brake line to wheel brake cylinder front left

VR = Brake line to wheel brake cylinder front right

HL = Brake line to wheel brake cylinder rear left

HR = Brake line to wheel brake cylinder rear right

2 = Motor relay

3 = Valve relay

4 = Ground cable

Arrows = Sealing points

The hydraulic modulator must not be repaired but only replaced as a completed unit.

Exception: Change of relay

8. When fast charging, disconnect the battery from the vehicle electrical system.
9. Take care that all connectors of the wiring harness are seated perfectly.
10. Never disconnect or connect the ABS wiring-harness plug from the controller when the ignition is switched on.
11. For reasons of safety, the hydraulic modulator must never be repaired, but be exchanged only as a complete unit.

Excepted from this are the motor relay and the valve relay.

Both relays may be exchanged.

Apart from the brake-line connections, no screws at the hydraulic modulator may be loosened.

Once they are loosened, it is impossible to make the brake circuits leak-free ever again!

There is danger to life!

Caution when handling brake fluid!

- a) Fill brake fluid only into containers from which no one would mistakenly drink the fluid.
(D a n g e r - p o i s o n o u s !)
- b) Even slight traces of mineral oil leads to failure of the brake system. Take particular care with respect to colorless through to yellow-dyed brake fluid, since the danger of a mix-up is in this case greatest. If mineral oil is found in the brake system or there is suspicion of this being the case, thoroughly flush out the complete brake system with brake fluid. In addition, replace the main cylinder.
- c) Do not allow brake fluid to come into contact with the vehicle paintwork, since the fluid contains elements which act as solvents for paint.
- d) Brake fluid is highly hygroscopic, i.e. it absorbs moisture from the air, which lowers its boiling point. For this reason, store brake fluid only in well-sealed storage containers.

Note:

During the course of the service life of brake fluid, its boiling point drops through continuous absorption of moisture from the atmosphere. In the case of very high loading of the brakes, vapor bubbles may therefore develop in the brake system.

Therefore, replace the brake fluid once a year, preferably in Spring.

OPERATION AND TESTING OF THE ABS WARNING LAMP

A vehicle equipped with ABS comes into the workshop with one of the following customer complaints:

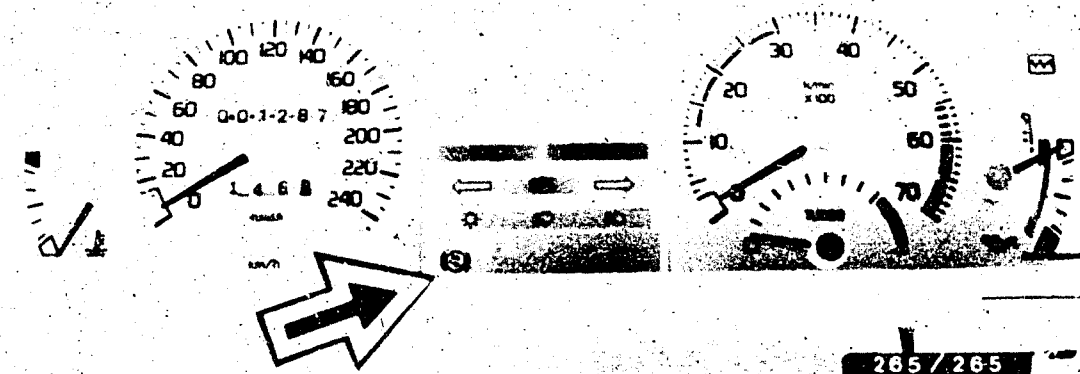
- * Warning lamp does not light up after switching on ignition.
- * Warning lamp does not go out after reaching idle speed.
- * Warning lamp lights up again while driving or lights up occasionally.

Make sure of the circumstances before checking the complete ABS system with the ABS tester.

For reasons of safety, testing of the ABS is permitted only with the ABS tester.

When connecting the ABS tester, just as when disconnecting and connecting the controller, the ignition must always be switched off.

The following gives information about the functioning and malfunctioning of the ABS warning lamp.



Arrow = ABS warning lamp

ABS warning lamp operation

When the ignition is switched on, the warning lamp lights up.

After starting and reaching idle speed, the ABS warning lamp goes out (oil-pressure switch supplies voltage to ABS controller).

If, after starting, the vehicle first exceeds a speed of approx. 6 km/h with all four wheels, the ABS system checks itself automatically (BITE sequence).

This procedure is repeated after each time the ignition is switched off and the engine re-started.

In addition, the ABS checks itself continuously within a certain range during the journey.

Incorrect warning-lamp indications are:

- * Warning lamp does not light up after switching on ignition.
- * Warning lamp does not go out after reaching idle speed.
- * Warning lamp lights up when driving or lights up occasionally.

Lighting-up of the ABS warning lamp indicates to the driver that the ABS is defective.

Nevertheless, braking can still take place with the conventional brake system.

However, it is possible for the wheels to lock.

General information:

Occasional lighting up of the warning lamp may be brought about through the battery being insufficiently charged.

The lamp lights up only as long as there is under-voltage, e.g. after switching on consuming devices when at idle.

The causes of trouble can be determined with the assistance of the ABS tester.

OPERATION OF THE ABS2 LED TESTER

1. General

The BOSCH ABS2 LED TESTER checks the ABS components in a passenger car with hydraulic brake system.

The following BOSCH ABS systems can be checked:

- * All ABS 2 versions (at present, ABS 2, ABS 2 B)
- * ABS 2 B-function of the electronic traction control (ETC)

The tester checks the peripheral system components in 6 program steps:

- * Hydraulic modulator
- * Motor relay
- * Valve relay
- * Wheel-speed sensors
- * Warning lamp
- * Acceleration sensor
- * Wiring harness
- * Plug connections
- * Ground cables
- * Stop-lamp switch signal
- * Generator signal

The ABS controller is not tested.

Self-diagnosis within the ABS controller makes additional testing of the controller with the tester unnecessary.

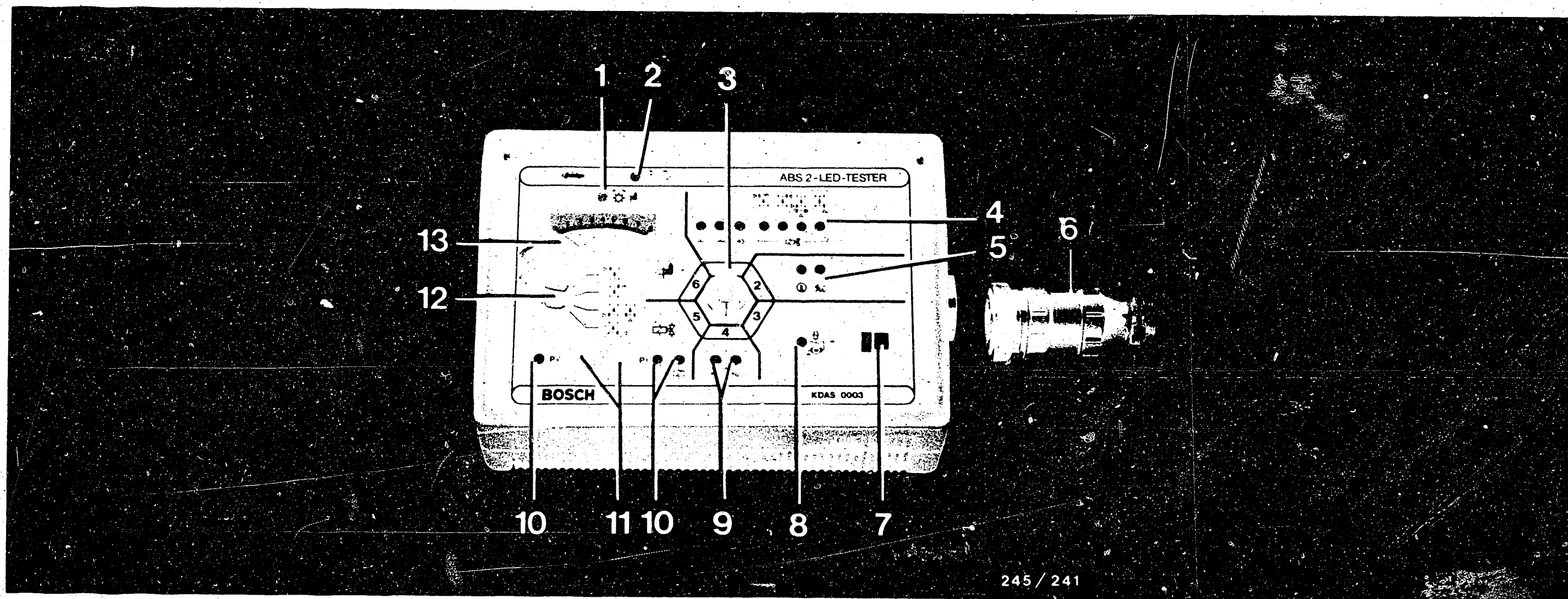
A brake test bench is not required for testing the ABS.

If a brake test bench is used, there is a danger of the vehicle jumping off the rollers!

Responsibility lies with the testing personnel if a brake test bench is used.

2. Structure of tester

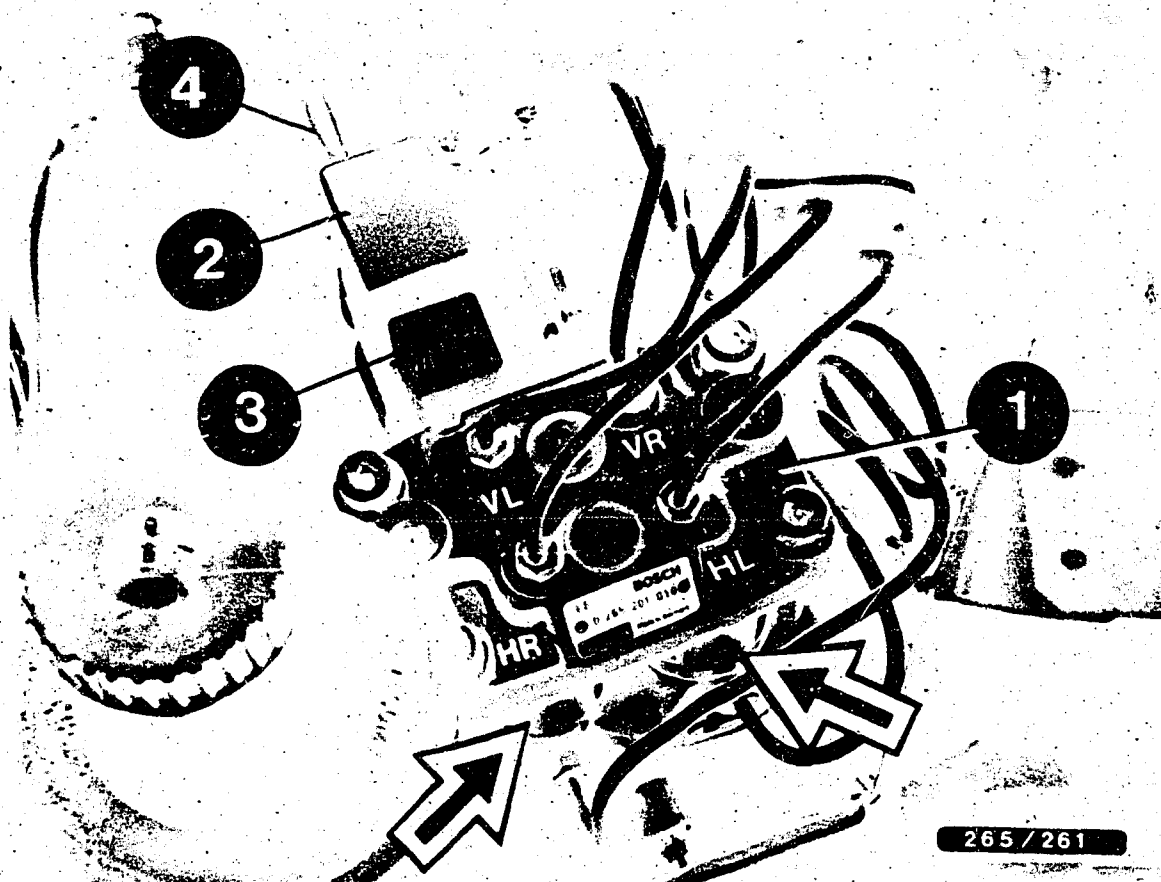
Failure is indicated by light-emitting diodes (LEDs), with the exception of wheel-speed sensor signals which are read off at the indicating instrument.



245 / 241

- 1 = 1 LED indicator for wheel speed in program-selector-switch position 6
- 2 = 1 LED indicator for battery voltage
- 3 = Program switch
- 4 = 7 LED indicators for program-selector-switch position 1
- 5 = 2 LED indicators for program-selector-switch position 2
- 6 = ABS adapter lead for connection to ABS wiring harness in vehicle
- 7 = Push-button for motor-relay control in program-selector-switch position 3
- 8 = 1 LED indicator for program-selector-switch position 3
- 9 = 2 LED indicators for program-selector-switch position 4
- 10 = 3 LED indicators for program-selector-switch position 5
- 11 = 2 push-buttons for tripping solenoid-operated valve functions.
Pressure-holding and pressure-release in program-selector-switch position 5
- 12 = Rotary switch for selection of individual wheels.
Functional in program-selector-switch position 5 and 6
- 13 = Indicating instrument for program-selector-switch position 6

Structure of tester (Continued)



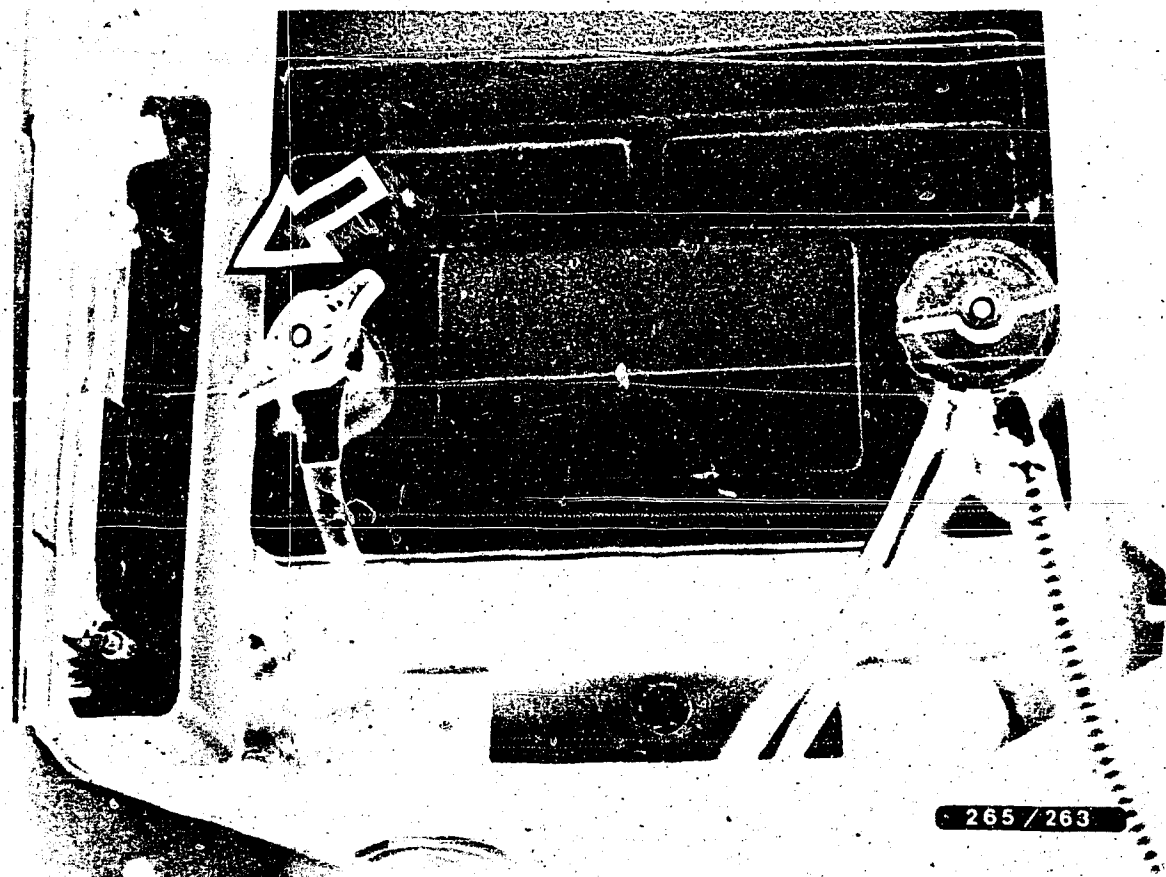
- 1 = Hydraulic modulator
- 2 = Motor relay
- 3 = Valve relay
- 4 = Ground cable

Arrows = Sealing points

TEST REQUIREMENTS FOR TESTING WITH ABS 2 LED TESTER

- * Regulatory tire size fitted?
- * Check for firm seating of ground for return supply pump.
- * Check for firm seating of ground strap between engine block and vehicle frame.
- * Check for leaks (visual examination) in hydraulic connections at hydraulic modulator and sealing points (arrows).

- * If the ABS warning lamp lights up intermittently when driving (e.g. after switching on consuming devices) and goes out again by itself, check battery and voltage supply (generator, regulator and voltage drops).
- * If the ABS warning lamp lights up continuously and does not go out, check the following points:
 - > Is controller plug sitting correctly and latched?
All plug contacts O.K.?
Spring contacts latched?
 - > Is oil-pressure switch supplying voltage?
Plug connection and lead to ABS controller O.K.?



Arrow = Controller for ABS

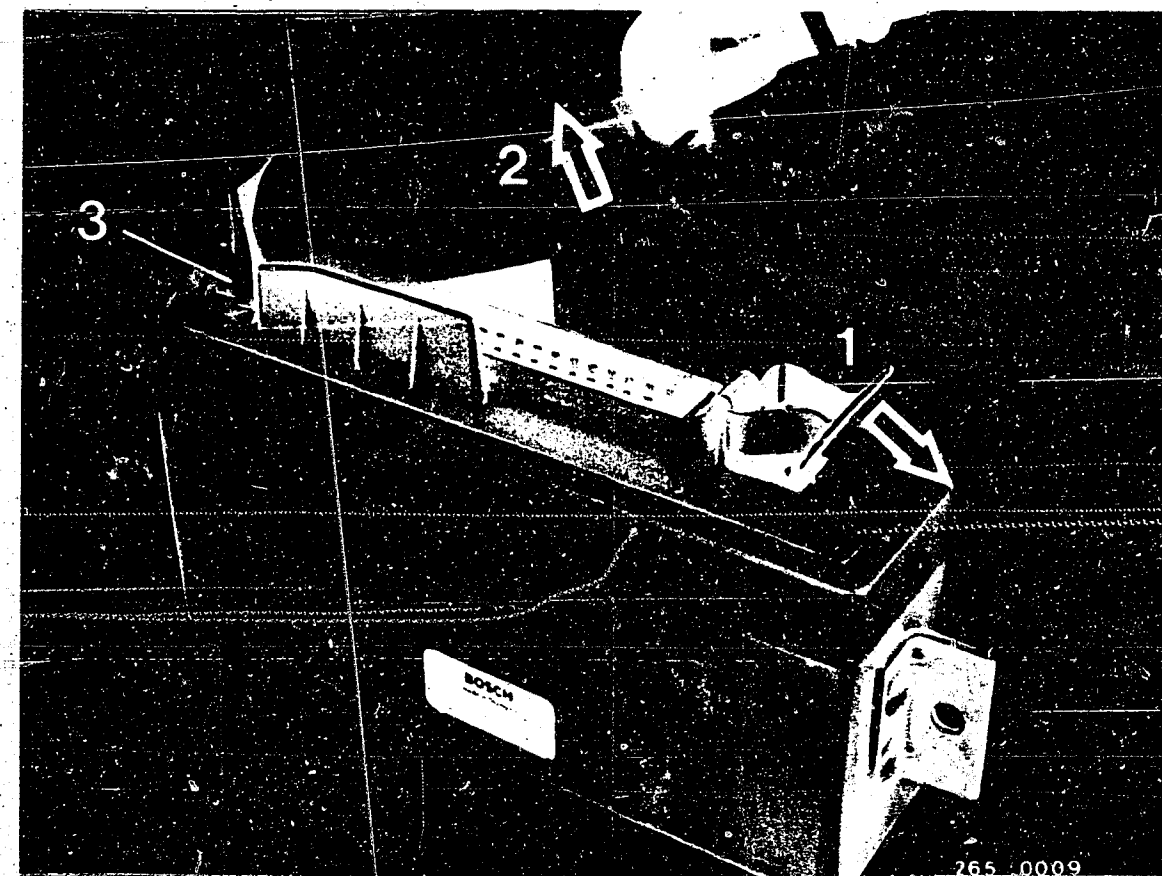
* Connect LED tester to ABS wiring harness.

Caution!

Disconnect and connect controller only when ignition switched off.

The installation position of the controller is in the engine compartment to the right of the battery beneath a cover.

To connect the tester, loosen fastening screws of controller.



- 1 = Spring
- 2 = Controller plug (35-pin)
- 3 = Coding unit

Switch off ignition before disconnecting controller plug.

Push back spring, pivot controller plug upwards and disconnect from coding unit.

- * For checking with tester, switch on ignition in all program-selector-switch positions (tester operates with current supply from vehicle battery).
- * One LED (green) indicates whether the voltage is sufficient.

Caution!

Do not run with tester connected!

After each repair, repeat the complete test program.

General note for trouble-shooting

Check all leads for short circuit to ground and contact with positive leads and watch out for rubbed and pinched locations.

For production reasons:
continued on the following
coordinate.

TEST CHART FOR ABS 2 LED TESTER

TEST STEP 1 (TEST SPECIFICATIONS AND NOTES ON OPERATION)

Component/Operation

Voltage supply (term. 20 and term. 1)

* Operation: Position:
 Program switch all
 Push-button -

* Operation in vehicle:
 Ignition on.

* Test specification (indication)
 LED 1 (upper illustration) lights up continuously in all program-selector-switch positions.

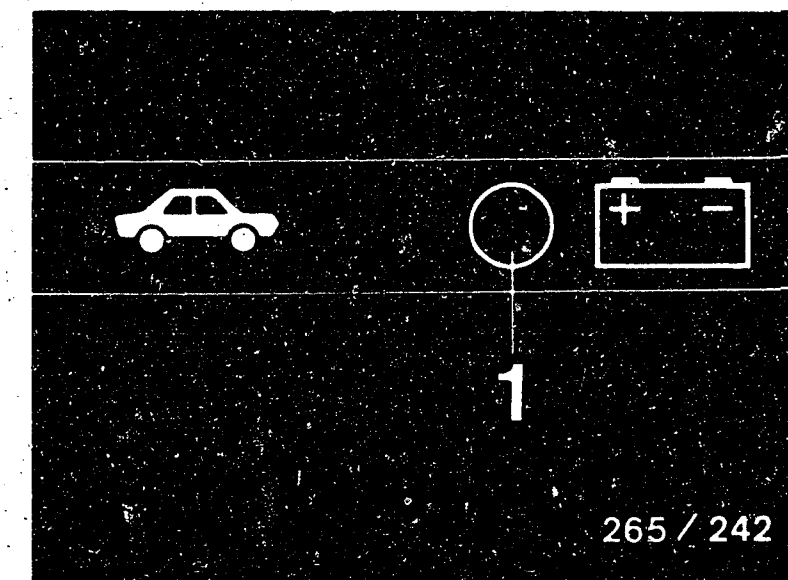
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Trouble-shooting:

Switch off ignition!

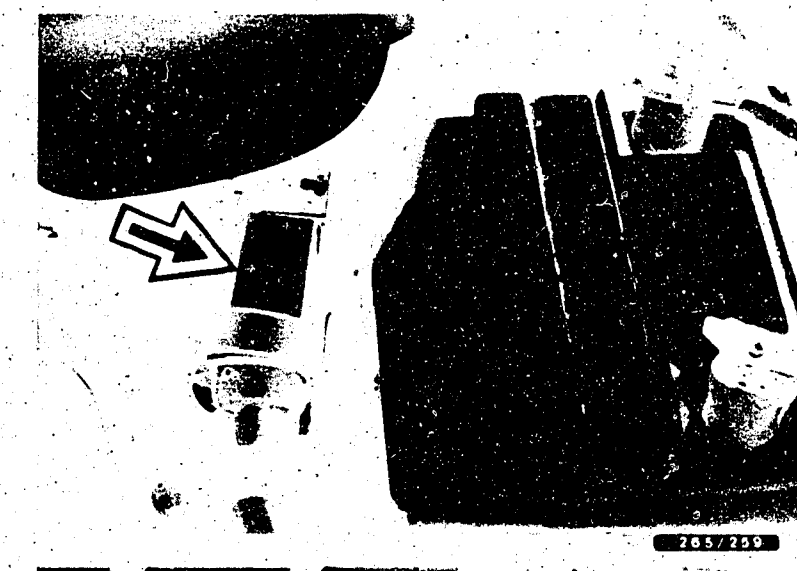
No indication:

- * Controller plug incorrectly connected
- * Over-voltage protection relay defective: exchange.



1 = LED for supply voltage

Arrow = Over-voltage protection relay



Continued C05

Continued on next coordinate

Check following leads:

- * Positive lead from B+ to over-voltage protection relay term.30(1).
- * Negative lead from over-voltage protection relay term.31b(3) to ground.
- * Negative lead from over-voltage protection relay 31b to controller plug K1/term.10.
- * ABS ground terminal at right headlamp must be bare metal and have no contact resistance.
- * Positive lead from over-voltage protection relay term.30a(5) to controller plug K1/term.1 via 4-pin plug connection.
- * Positive lead from over-voltage protection relay term.86(2) to driving switch term.15.
- * Check for firm seating of ground strap between engine block and vehicle frame.

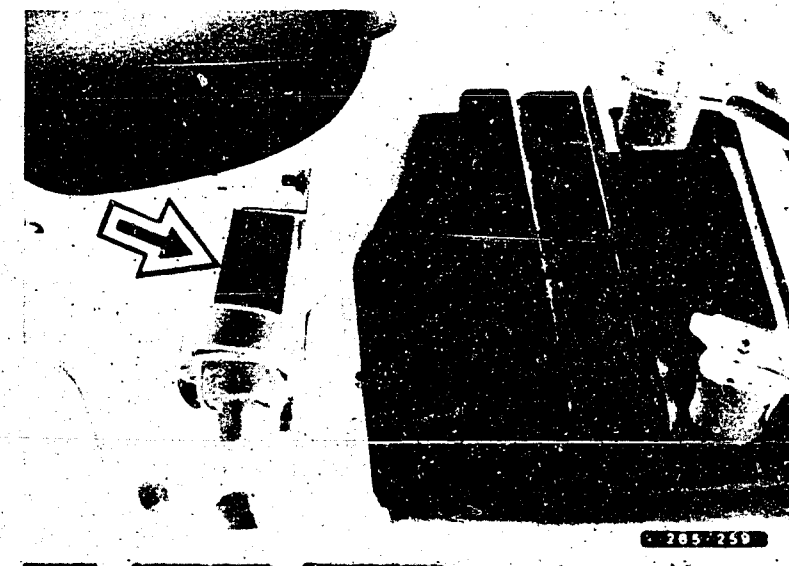
LED 1 (green) lights up occasionally during the course of the test:

Interrupt test and eliminate trouble.

Causes of trouble:

1. Battery insufficiently charged.
Charge battery or run engine.
2. Voltage drops too high at ABS ground terminal, ground terminal must be bare metal.

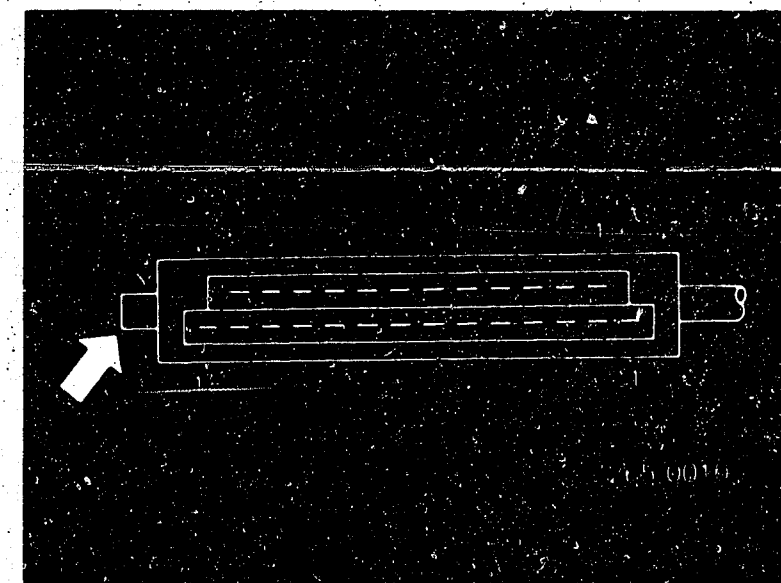
After eliminating trouble, carry out complete test program.



Arrow = Over-voltage protection relay

Top view of controller plug K1 (35-pin) with terminal numbers.

Arrow = Lug with mechanical encoding



Component/Operation:

N>

Ground (term.34, term.10)
 Diode for warning lamp (term.29,
 term.32)
 Solenoid-operated valve internal
 resistances (term. 2, term.35,
 term.18, term.19)
 Off-position and ground of
 valve relay
 ABS warning lamp.

* Operation:	Position:
Program switch	1
Push-button	-

* Operation in vehicle:
 Ignition on.

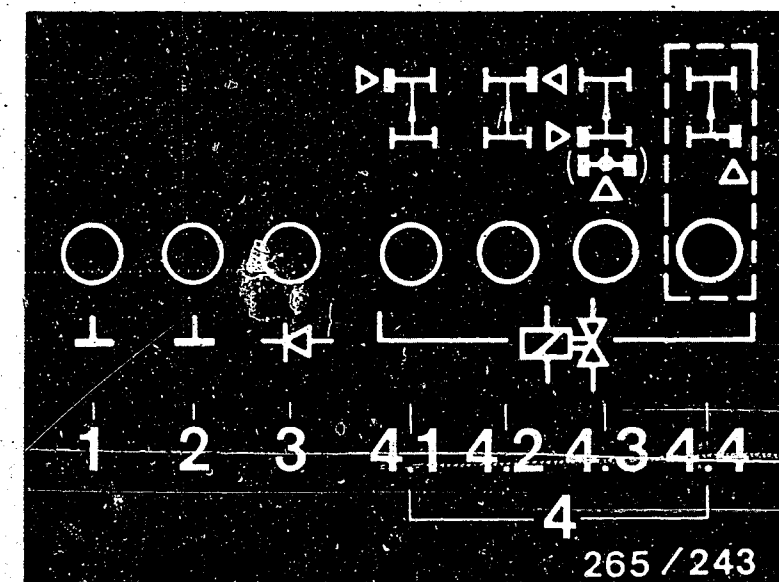
* Test specification (indication)
 LED 1 to LED 4.4
 light up equally brightly (see
 upper illustration).

ABS warning lamp in vehicle must
 light up.

Trouble-shooting:Switch off ignition!

1. LED 1 and/or 2
(upper illustration) does not
light up:

* Check ground terminal at right
 headlamp as well as ground strap
 between engine block and vehicle
 frame for firm seating, too high
 contact resistance and for short
 circuit.



Continued C17

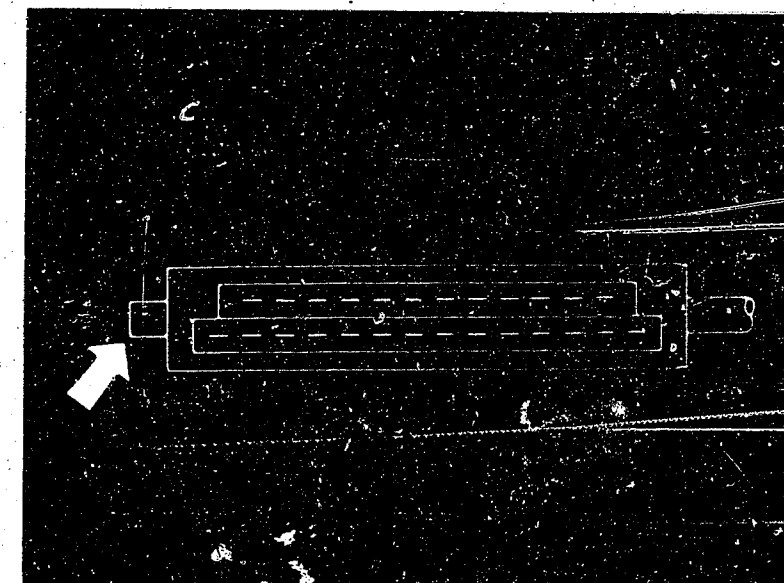
Continued on next coordinate

TEST STEP 2 (CONTINUED) (TEST SPECIFICATIONS AND OPERATING INSTRUCTIONS)

- * Check for contact resistance and short circuit of ground lead from controller plug K1/term.10 via over-voltage protection relay term.31b(3) to ground terminal.
- * Check for contact resistance and short circuit of lead from ground to controller plug K1/term.34.
- * Valve relay defective.
Caution! Use only relay with correct electrical terminal assignment.

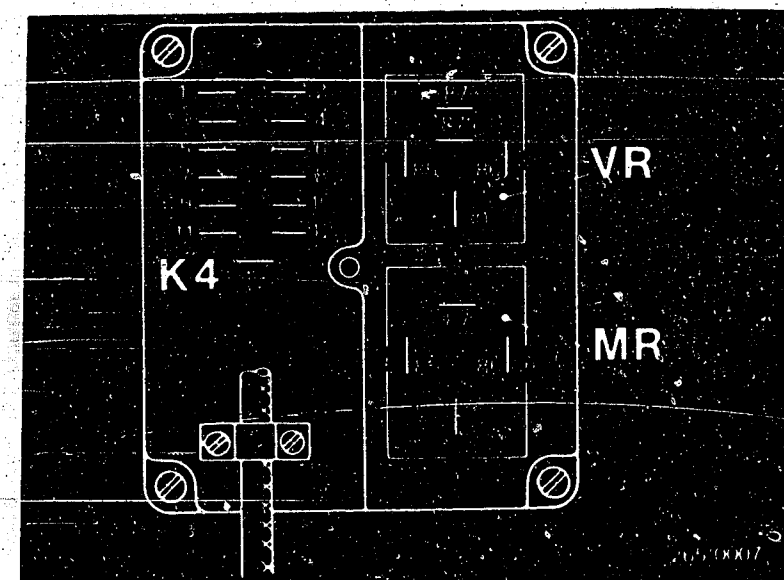
2. LED 3 does not light up:

- * Check diode in forward direction and reverse direction with ohmmeter between K4/term.10 and K4/term.12.
If diode defective, replace hydraulic modulator.
- * Check for contact resistance and short circuit in ground of valve relay:
From plug K3/term.8 to ground terminal.



Top view of controller plug K1 (35-pin) with terminal numbers.
Arrow = Lug with mechanical encoding

Plug plate of hydraulic mod., position of terminals:
VR = Valve relay
MR = Motor relay
K4 = Wiring-harness plug



One or several LED 4 do not light up:

* Measure internal resistance directly at hydraulic modulator.

Test specifications:

Valve VL (LED 4.1) between K4/term.1 and K4/term.12: 0,7...1,7 Ω
 Valve VR (LED 4.2) between K4/term.3 and K4/term.12: 0,7...1,7 Ω
 Valve HL (LED 4.3) between K4/term.5 and K4/term.12: 0,7...1,7 Ω
 Valve HR (LED 4.4) between K4/term.7 and K4/term.12: 0,7...1,7 Ω

* If test specification not obtained:
 Exchange hydraulic modulator.

* Check leads for continuity (test specification: 0 Ω):

Valve VL (LED 4.1) between K3/term.1
 and controller plug K1/term.2
 Valve VR (LED 4.2) between K3/term.3
 and controller plug K1/term.35
 Valve HL (LED 4.3) between K3/term.5
 and controller plug K1/term.18
 Valve HR (LED 4.4) between K3/term.7
 and controller plug K1/term.19

If test specification not obtained:

Check plug connection for short circuit, corrosion and mechanical defects. Eliminate interruption.

3. All LED 4 and LED 3 do not light up:

* Check for contact resistance and short circuit in ground of valve relay:

From plug K3/term.8 to ground terminal.

* Valve relay defective.

4. Weak lighting up of one LED:

* This means contact resistance in the corresponding current path.

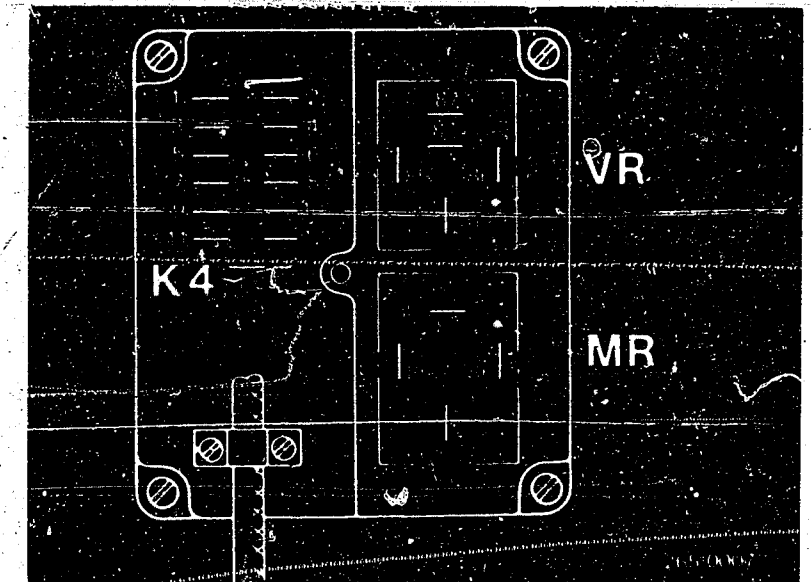
5. ABS warning lamp does not light up:

Warning lamp defective.

Check lead to driving switch term.15 and controller term.29.

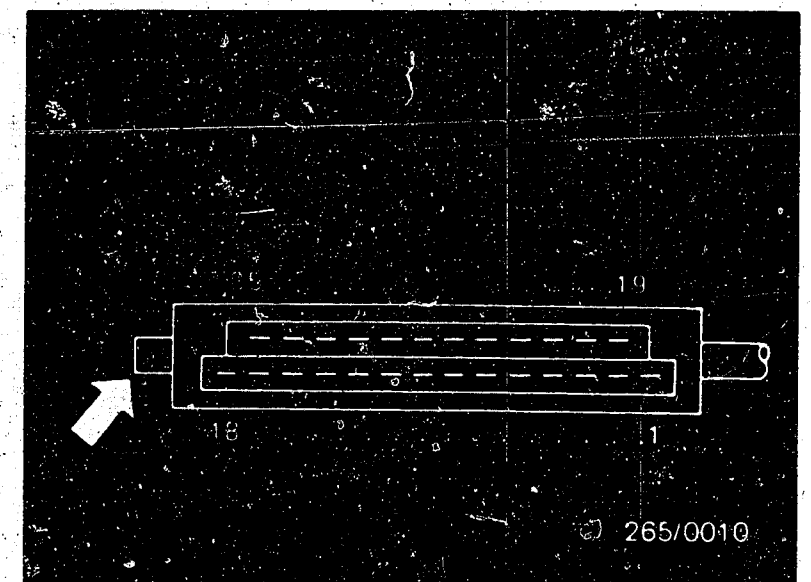
Note:

All 7 of the other LEDs must light up.



Plug plate of hydraulic mod.,
 position of terminals:
 VR = Valve relay
 MR = Motor relay
 K4 = Wiring-harness plug

Top view of controller plug
 K1 (35-pin) with terminal
 numbers.
 Arrow = Lug with mechanical
 encoding



Removing the hydraulic modulator

- * For reasons of safety, the hydraulic modulator must not be repaired, but replaced only as a complete unit.

Excepted are the motor and valve relays.
Both relays may be replaced.

- * Excepting brake-line connections, no screws on the hydraulic modulator may be loosened.

In particular, the hexagon-socket-head cap screws or Torx screws must under no circumstances be loosened.

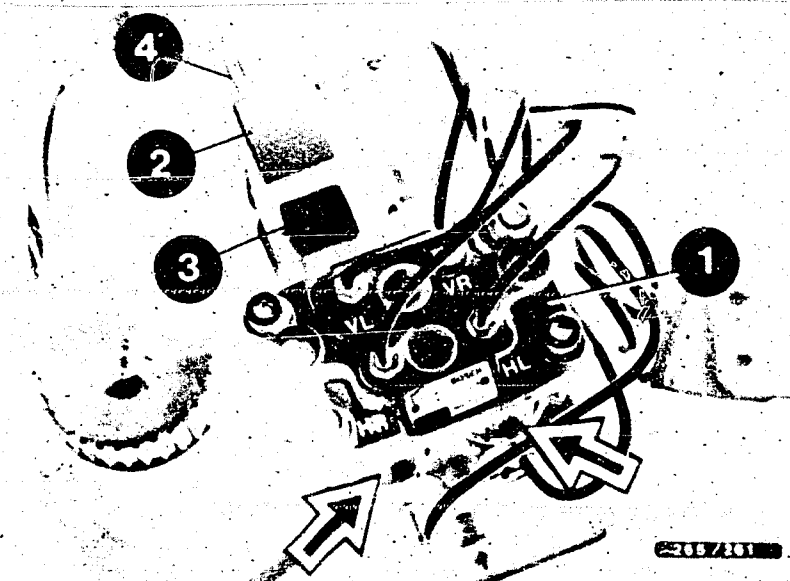
After loosening, the brake circuits can never be sealed again.

D a n g e r t o l i f e !

- * Make visual examination for leaks in hydraulic modulator and brake-line connections.

Pay particular attention to the sealing points indicated by arrows (upper illustration).

If brake fluid is escaping, tighten (12...16 Nm) or replace the brake-line connections, or replace the hydraulic modulator.



- 1 = Hydraulic modulator
- 2 = Motor relay
- 3 = Valve relay
- 4 = Ground cable
- Arrows = Sealing points

At the base of the hydraulic modulator is a ventilation bore to the pump plunger.

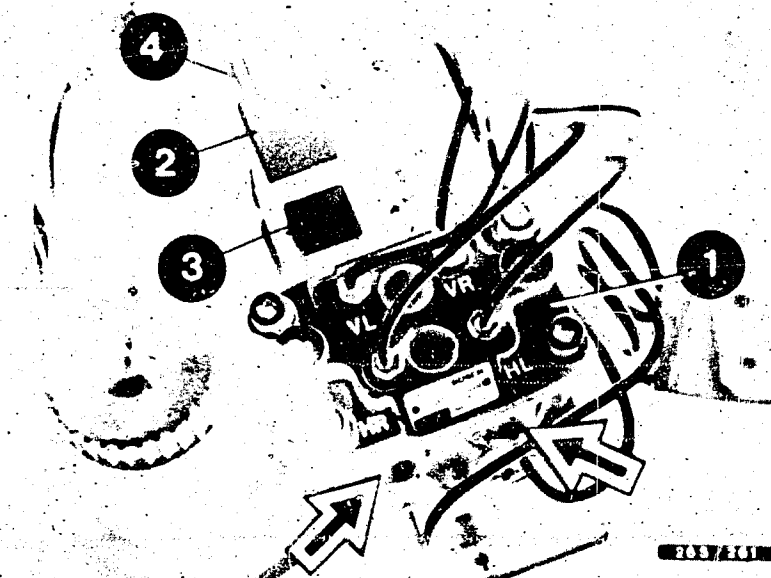
Slight escaping of brake fluid may occur at this point.

A claim is justified only if a puddle of brake fluid forms beneath the hydraulic modulator after repeated actuation of the brake pedal.

* When removing and installing the brake lines, take care that the lines are re-connected correctly assigned, in accordance with the coding at the hydraulic modulator (e.g. "VL" of hydraulic modulator must be connected to the wheel brake cylinder, front left).

* Coding at hydraulic modulator:

VL = Connection for brake line, front left	(wheel brake cylinder)
VR = Connection for brake line, front right	(wheel brake cylinder)
HL = Connection for brake line, rear left	(wheel brake cylinder)
HR = Connection for brake line, rear right	(wheel brake cylinder)

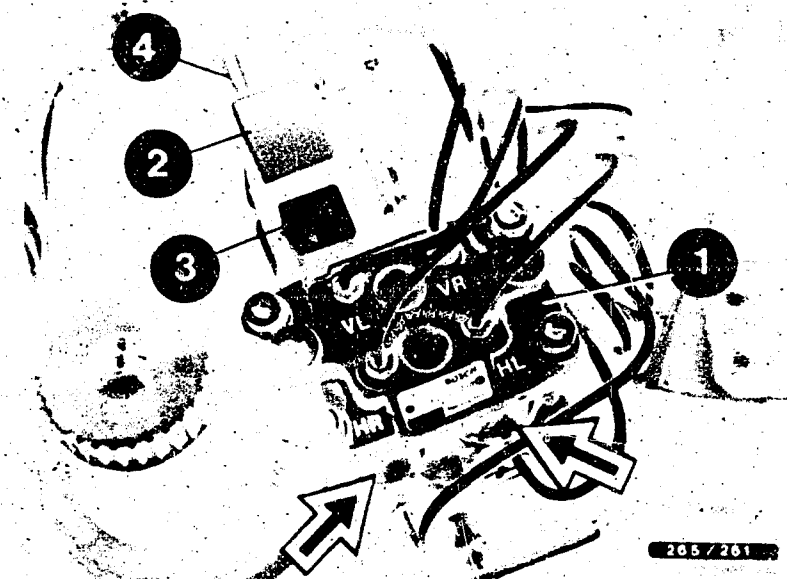


1	= Hydraulic modulator
2	= Motor relay
3	= Valve relay
4	= Ground cable
Arrows	= Sealing points

- * Use only the specified double-head box wrench 9 x 11 mm for loosening and tightening the brake lines.
- * Code brake lines and loosen from hydraulic modulator.
- * Catch brake fluid and avoid contact with skin, clothing or paintwork!
- * Seal brake lines and connections immediately with dummy plugs.
- * Disconnect ground cable at pump motor.
- * Loosen fastening screw and remove cap.
- * Loosen hoop and remove plug.
- * Loosen hexagon nuts of bracket and remove hydraulic modulator.

Installation

- * Position hydraulic modulator into bracket and tighten with the hexagon nuts.
- * Connect ground cable to pump motor. Connect 13-pin plug and fasten with the hoop.
- * Tighten cap with screw on the hydraulic modulator.
- * Connect brake lines to hydraulic modulator according to coding.
- * Pay attention to tightening torque for brake-line connections at hydraulic modulator: 12...16 Nm.
- * Bleed brake system and check for leaks.
- * Thoroughly check ABS with tester.



- 1 = Hydraulic modulator
- 2 = Motor relay
- 3 = Valve relay
- 4 = Ground cable
- Arrows = Sealing points

TEST STEP 3

(TEST SPECIFICATIONS AND NOTES ON OPERATION)

Component/Operation:Voltage of oil-pressure switch
(term.15)

N>

* Operation:	Position:
Program switch	2
Push-button	-

* Operation in vehicle:
Ignition on* Test specification (indication):
LED 1 (upper illustration) lights up.* Operation in vehicle:
Start engine.* Test specification (indication):
LED 1 (upper illustration) goes out when engine running.Trouble-shooting:LED 1 does not go out when engine running:

* Accelerate briefly. If LED 1 goes out, test O.K.

* Voltage measurement at K1/term. 15 with engine running.
Test specification: greater than 10 V.

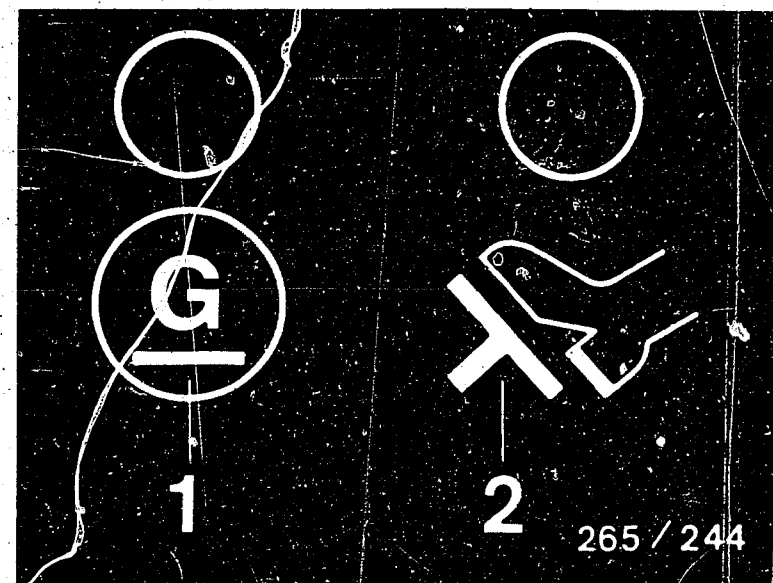
Test specification not obtained:

* Check lead to oil-pressure switch.

* Oil-pressure switch defective.

* 4-pin plug connection defective:

- corroded,
- short circuited,
- mechanically opened out,
- incorrectly connected.



Continued on next coordinate

Continued on next coordinate

C17

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C18

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Component/Operation:

Stop-lamp switch (term.25)

* Operation:	Position:
Program switch	2
Push-button	-

* Operation in vehicle:

Ignition on.

* Test specification (indication)
LED 2 (upper illustration) lights up.

* Operation in vehicle:

Actuate brake pedal.

* Test specification (indication)
LED 2 (upper illustration) goes out.

Trouble-shooting:

1. LED 2 does not light up:

* Stop lamps defective. High contact resistance of stop lamps or of their ground. Short circuit in lead from controller K125 to stop-lamp switch.

2. LED does not go out or becomes only slightly dimmer:

* Stop-lamp switch fuse in fuse box defective.

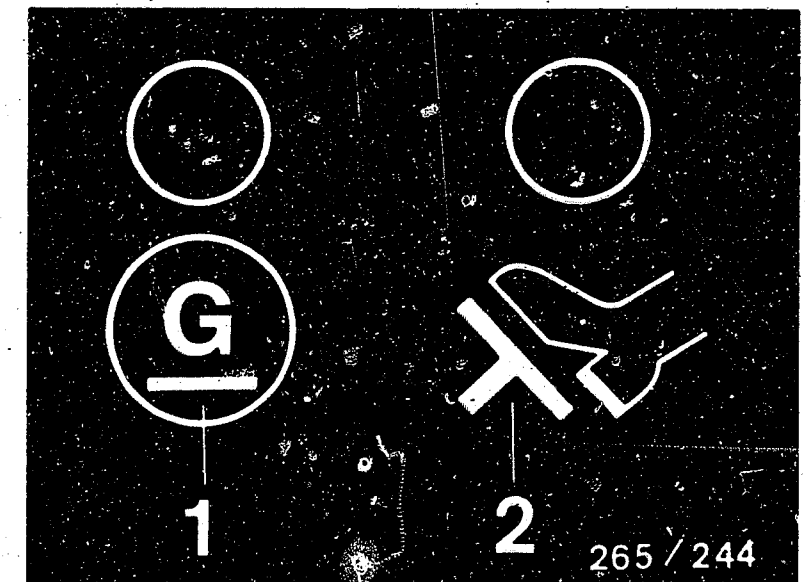
* Voltage drop at stop-lamp switch (switch defective) or its plug connections.

* Stop-lamp switch defective.

* Lead to stop-lamp switch incorrectly connected.

* 4-pin plug connection defective:

- corroded,
- short circuited,
- mechanically opened out,
- incorrectly connected.



Component/Operation:

Pump-motor motor relay in hydraulic modulator
(term.28, term.14).

* Operation:	Position:
Program switch	3
Push-button (upper ill.)	2

* Operation in vehicle:

Ignition on.
Keep push-button 2 (upper ill.) pressed.

* Test specification (indication):

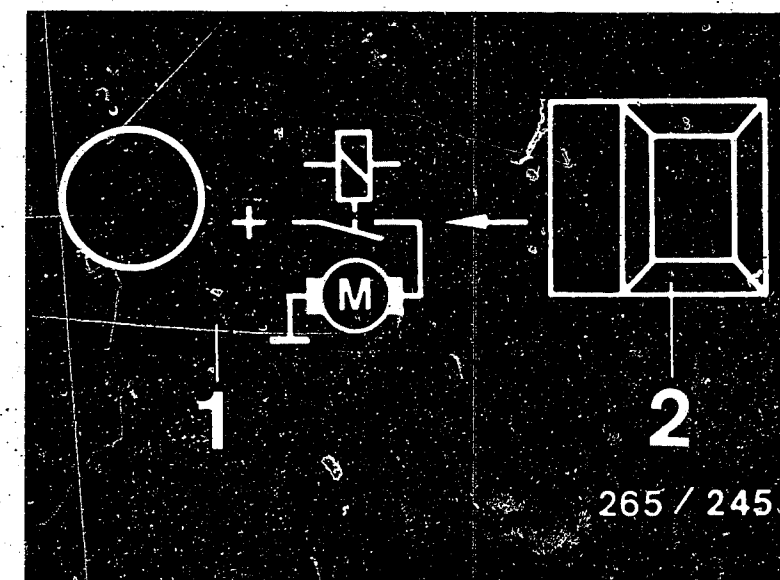
LED 1 lights up, pump motor runs.

After releasing the push-button,
LED 1 stays lit due to run-on of
motor (upper illustration).

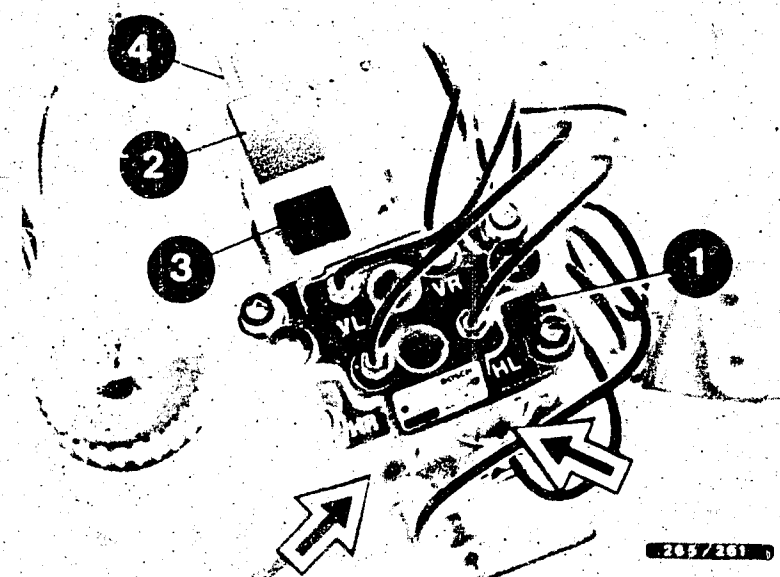
Trouble-shooting:Switch off ignition:

1. LED does not light up or pump
motor does not start:

* Motor relay defective (lower
illustration).



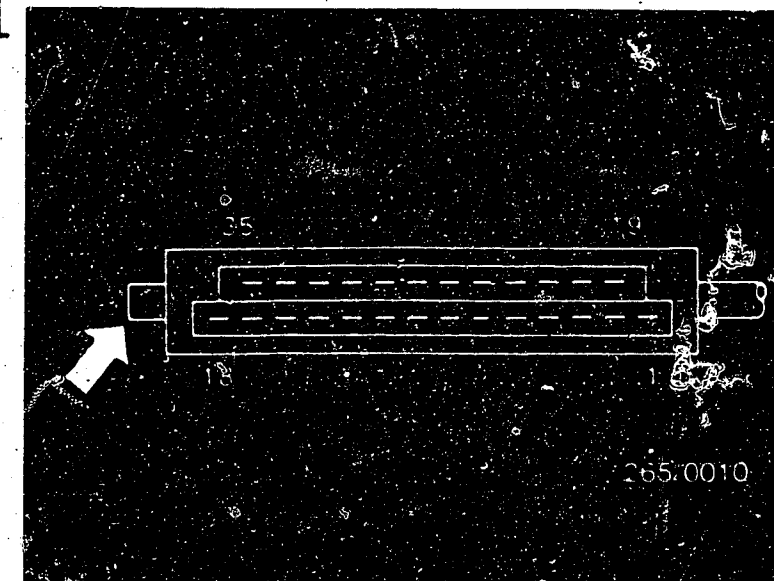
- 1 = Hydraulic modulator
2 = Motor relay
3 = Valve relay
4 = Ground cable
Arrows = Sealing points



Continued D03

Continued on next coordinate

- * Check following leads for continuity:
 - From controller plug K1/term.14 to plug K3/term.9.
 - From K4/term.9 to motor relay term.30.
 - From over-voltage protection relay term.30a(5) to plug K3/term.2.
 - From plug plate K4/term.2 to motor relay term.86.
 - From motor relay term.85 to K4/term.11.
 - From K3/term.11 to controller plug K1/term.28.
 - From motor relay term.87 to K4/term.13.
 - From K3/term.13 to term.B+.

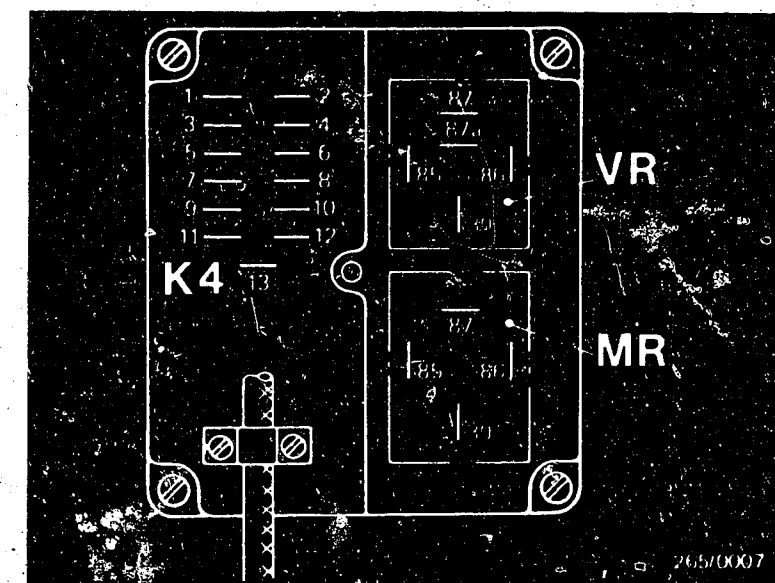


Top view of controller plug K1 (35-pin) with terminal numbers.
Arrow = Lug with mechanical encoding

2. Pump motor does not run or LED does not stay lit or very briefly stays lit:

- * Check for firm seating of and contact resistance in ground terminal of pump motor.
- * Check for firm seating of positive connection of pump motor.
Check lead from positive connection of pump motor to motor relay term.30.
Check pump motor for continuity.
- * Pump motor defective: exchange hydraulic modulator.

Plug plate of hydraulic mod.,
position of terminals:
VR = Valve relay
MR = Motor relay
K4 = Wiring-harness plug



Removing the hydraulic modulator

- * For reasons of safety, the hydraulic modulator must not be repaired, but replaced only as a complete unit.

Excepted are the motor and valve relays.
Both relays may be replaced.

- * Excepting brake-line connections, no screws on the hydraulic modulator may be loosened.

In particular, the hexagon-socket-head cap screws or Torx screws must under no circumstances be loosened.

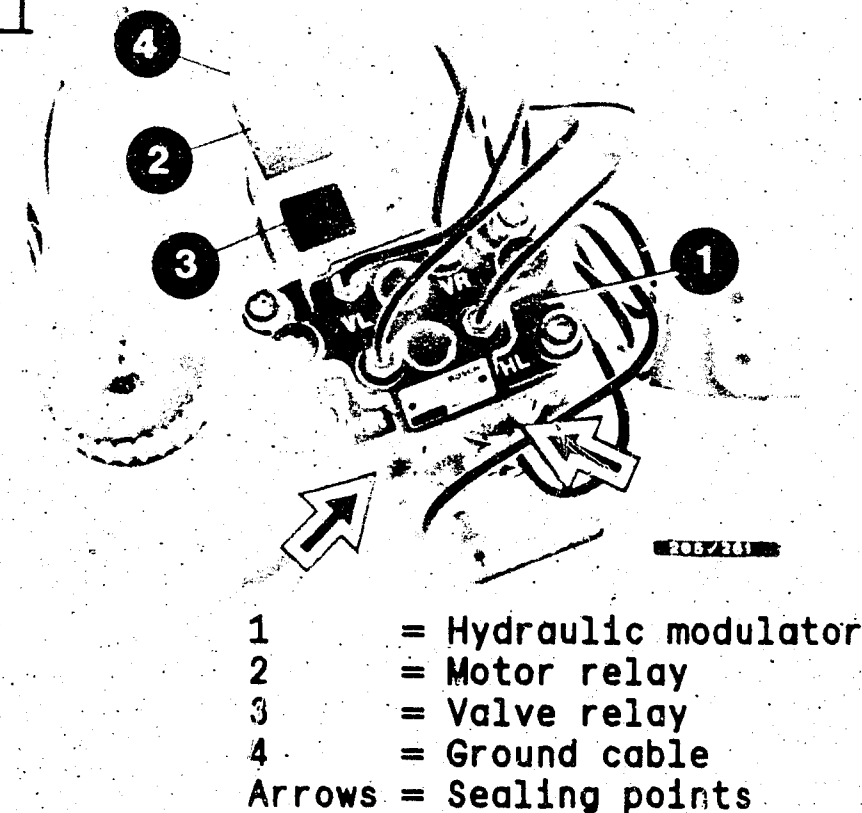
After loosening, the brake circuits can never be sealed again.

D a n g e r t o l i f e !

- * Make visual examination for leaks in hydraulic modulator and brake-line connections.

Pay particular attention to the sealing points indicated by arrows (upper illustration).

If brake fluid is escaping, tighten (12...16 Nm) or replace the brake-line connections, or replace the hydraulic modulator.



At the base of the hydraulic modulator is a ventilation bore to the pump plunger.

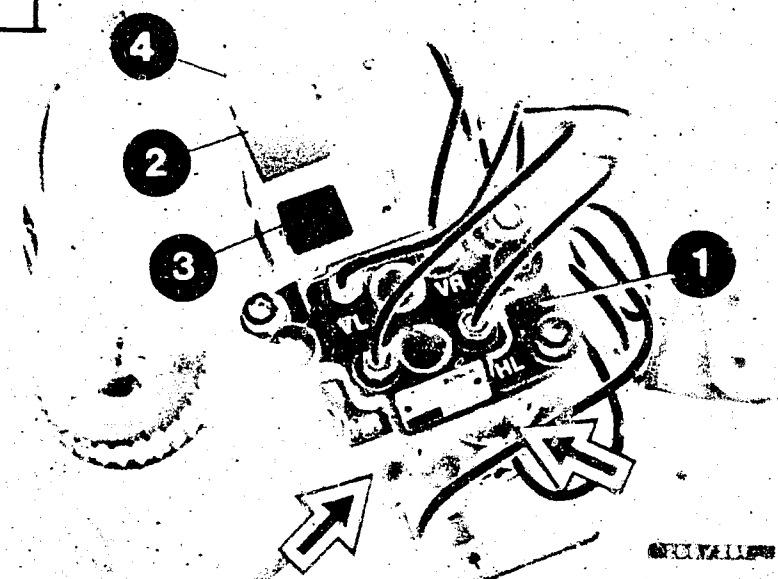
Slight escaping of brake fluid may occur at this point.

A claim is justified only if a puddle of brake fluid forms beneath the hydraulic modulator after repeated actuation of the brake pedal.

* When removing and installing the brake lines, take care that the lines are re-connected correctly assigned, in accordance with the coding at the hydraulic modulator (e.g. "VL" of hydraulic modulator must be connected to the wheel brake cylinder, front left).

* Coding at hydraulic modulator:

VL = Connection for brake line, front left (wheel brake cylinder)
 VR = Connection for brake line, front right (wheel brake cylinder)
 HL = Connection for brake line, rear left (wheel brake cylinder)
 HR = Connection for brake line, rear right (wheel brake cylinder)

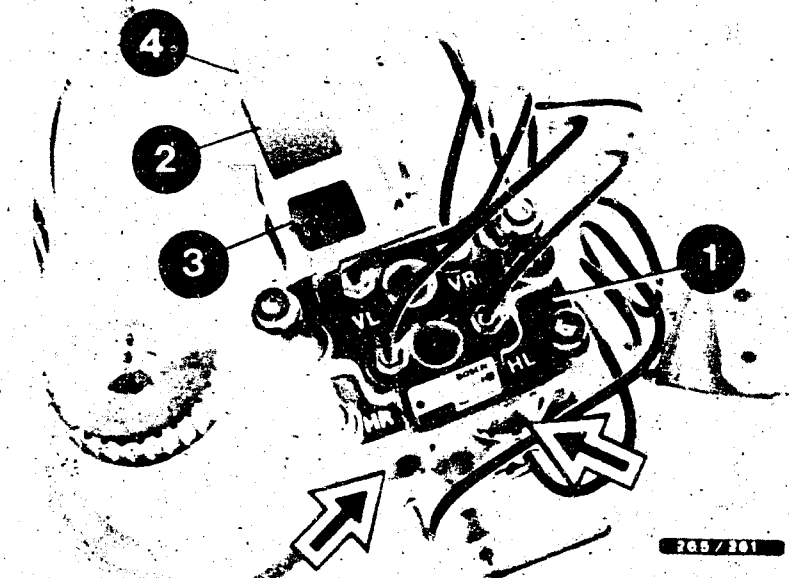


1 = Hydraulic modulator
 2 = Motor relay
 3 = Valve relay
 4 = Ground cable
 Arrows = Sealing points

- * Use only the specified double-head box wrench 9 x 11 mm for loosening and tightening the brake lines.
- * Code brake lines and loosen from hydraulic modulator.
- * Catch brake fluid and avoid contact with skin, clothing or paintwork!
- * Seal brake lines and connections immediately with dummy plugs.
- * Disconnect ground cable at pump motor.
- * Loosen fastening screw and remove cap.
- * Loosen hoop and remove plug.
- * Loosen hexagon nuts of bracket and remove hydraulic modulator.

Installation

- * Position hydraulic modulator into bracket and tighten with the hexagon nuts.
- * Connect ground cable to pump motor. Connect 13-pin plug and fasten with the hoop.
- * Tighten cap with screw on the hydraulic modulator.
- * Connect brake lines to hydraulic modulator according to coding.
- * Pay attention to tightening torque for brake-line connections at hydraulic modulator: 12...16 Nm.
- * Bleed brake system and check for leaks.
- * Thoroughly check ABS with tester.



- 1 = Hydraulic modulator
- 2 = Motor relay
- 3 = Valve relay
- 4 = Ground cable
- Arrows = Sealing points

TEST STEP 5

(TEST SPECIFICATIONS AND NOTES ON OPERATION)

Test step for program-selector-switch position 4 not applicable

Component/Operation:

Valve relay - Operation (term.27)

* Operation:	Position:
Program switch	5
Push-button*	-

* Operation in vehicle:
Ignition on.

* Test specification (indication):
LED 3 (upper ill.) lights up.

Trouble-shooting:

Switch off ignition:

No reading:

* Check for short circuit and contact resistance in following leads:

From K1/term.27 to K3/term.6

From K1/term.32 to K3/term.12

From K4/term.12 to valve relay term.30.

From K4/term.6 to valve relay term.85.

From K4/term.4 to valve relay term.87.

From K3/term.4 to B+.

From valve relay term.86 to motor relay term.86.

* Valve relay defective:
exchange.

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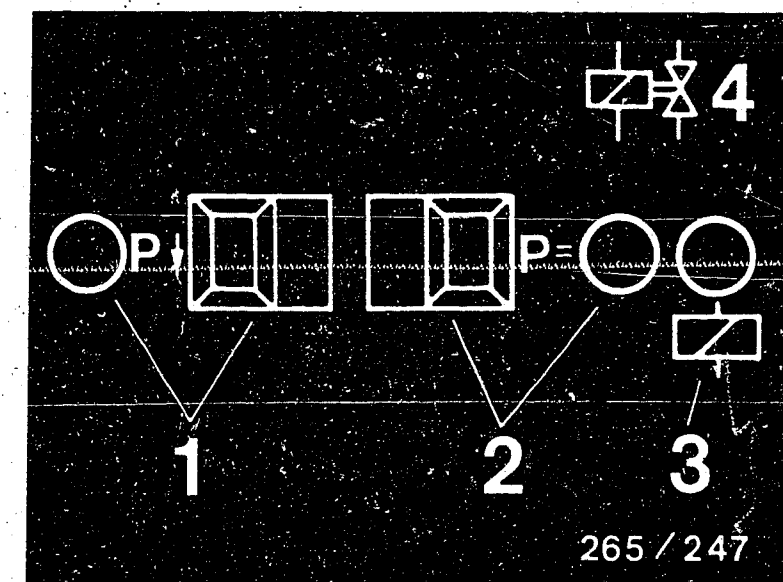
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D03

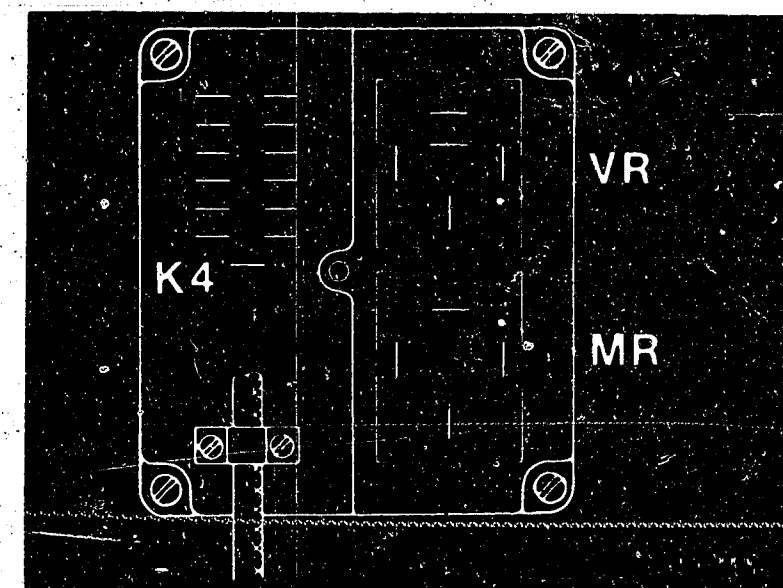
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D04

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Plug plate of hydraulic mod.,
position of terminals:
VR = Valve relay
MR = Motor relay
K4 = Wiring-harness plug



Component/Operation:

Check operation and for mix-up of solenoid-operated valves in hydraulic modulator.

Pressure-holding function point 1 to 3 and
Pressure-release function point 4 to 5.

Note:

Check each wheel separately in turn, observe operating sequence.

* Operation:	Position:
Program switch	5

* Operation in vehicle and at tester:

Chock up vehicle. The wheel being tested must be freely turnable by hand.

Ignition on.

Set switch 1 (upper ill.) for wheel selection to wheel to be tested.

1. (Lower illustration)

Push-button P = keep pressed

Test specification:

LED P = lights up.

N>

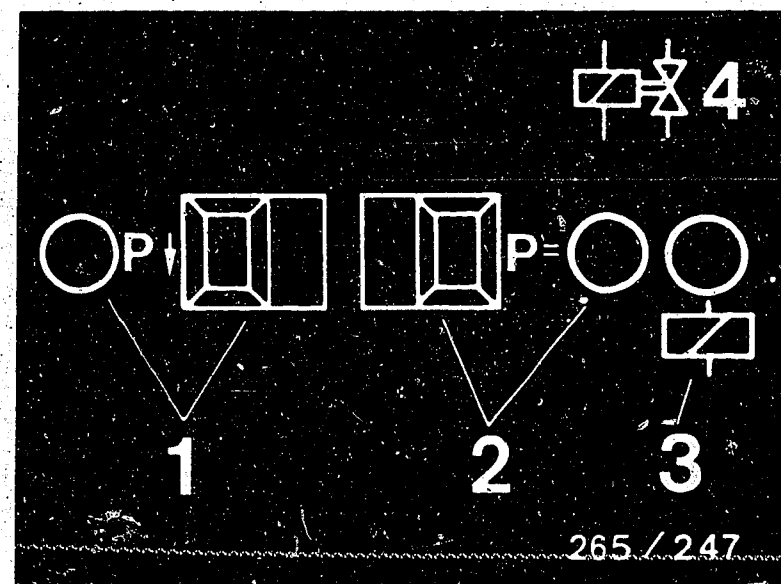
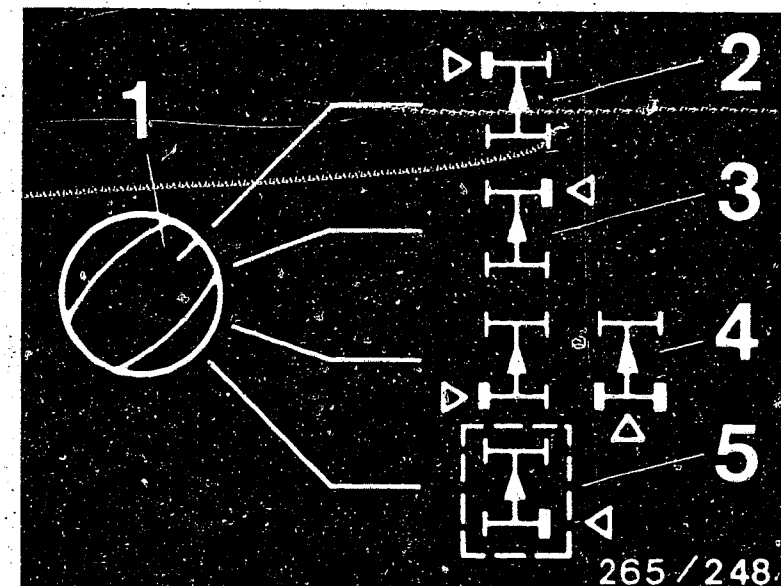
1. LED P (lower illustration) does not light up:

- * Battery insufficiently charged.
- * Repeat test with engine running.
- * Valve relay (make contact) defective.
- * Ground terminals must be bare and connected firmly.

Check for voltage drop and short circuit in following leads:

- * Ground cable from K1/term.10 via over-voltage protection relay term.31b(3) to ground.
- * Lead from controller plug K1/term.34 to ground.
- * Positive lead from plug K1/term.1 to over-voltage protection relay term.30a(5) via 4-pin plug connection.

Lead from valve relay term.87 to B+.



Continued on next coordinate

Continued on next coordinate

2. Keep brake pedal pressed

Test specification:

Wheel turnable by hand.

3. Push-button P = release
(upper illustration)

Test specification:

LED P = goes out, wheel locks.

4. Press push-button P arrow
(upper illustration)

Test specification:

LED P arrow lights up. Wheel turnable by hand.

5. Release push-button P arrow
(upper illustration)

Test specification:

LED P arrow goes out, wheel locks.

6. Release brake pedal.

N>

2. Locking of wheel or wheel cannot be turned:

- * Hydraulic brake lines at hydraulic modulator (lower illustration) mixed up.
- * Solenoid-operated valves correctly electrically connected?

Wheel, front left:
from plug K1/term.2
to K3/term.1.

Wheel, front right:
from plug K1/term.35
to K3/term.3.

Wheel, rear left:
from plug K1/term.18
to K3/term.5.

Wheel, rear right:
from plug K1/term.19
to K3/term.7.

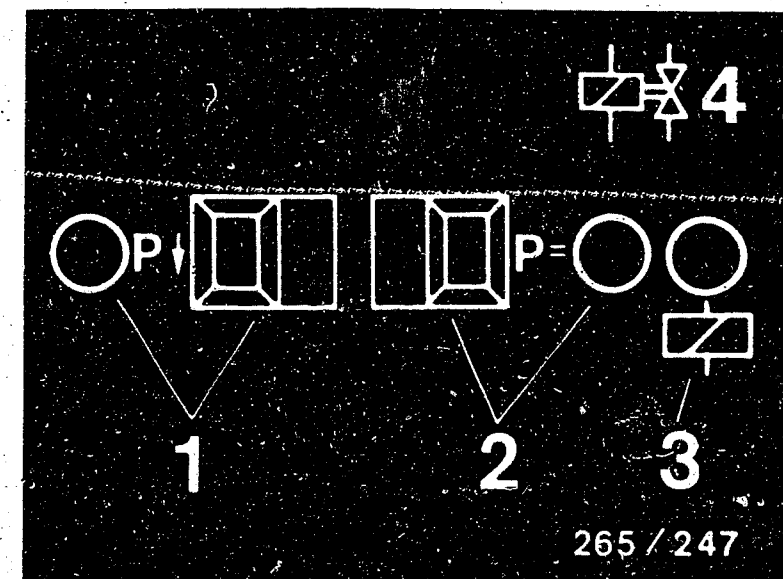
- * Check for firm seating of ground strap of pump.
Contact surfaces for terminals must be bare.

- * Check for voltage drop and firm seating of positive connection of pump.
Connection must be bare and firmly connected.

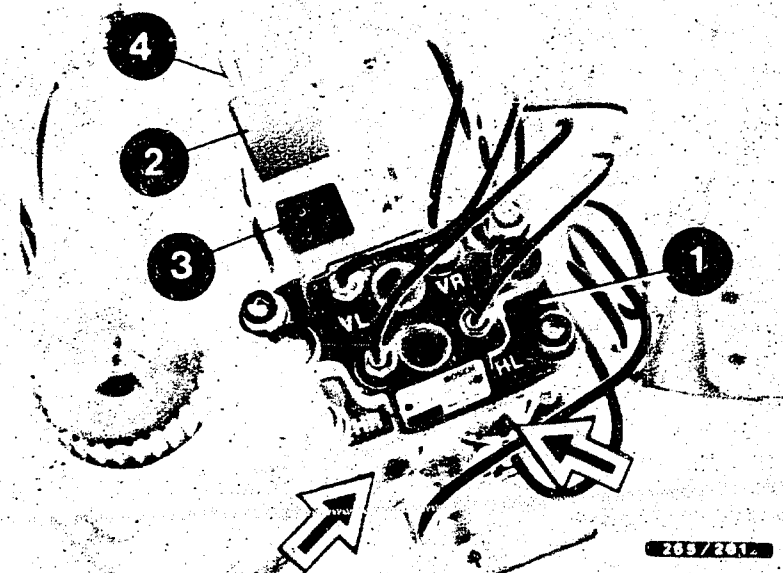
- * Hydraulic modulator defective.

Continued on next coordinate

Continued on next coordinate



- 1 = Hydraulic modulator
- 2 = Motor relay
- 3 = Valve relay
- 4 = Ground cable
- Arrows = Sealing points



Removing the hydraulic modulator

- * For reasons of safety, the hydraulic modulator must not be repaired, but replaced only as a complete unit.

Excepted are the motor and valve relays.
Both relays may be replaced.

- * Excepting brake-line connections, no screws on the hydraulic modulator may be loosened.

In particular, the hexagon-socket-head cap screws or Torx screws must under no circumstances be loosened.

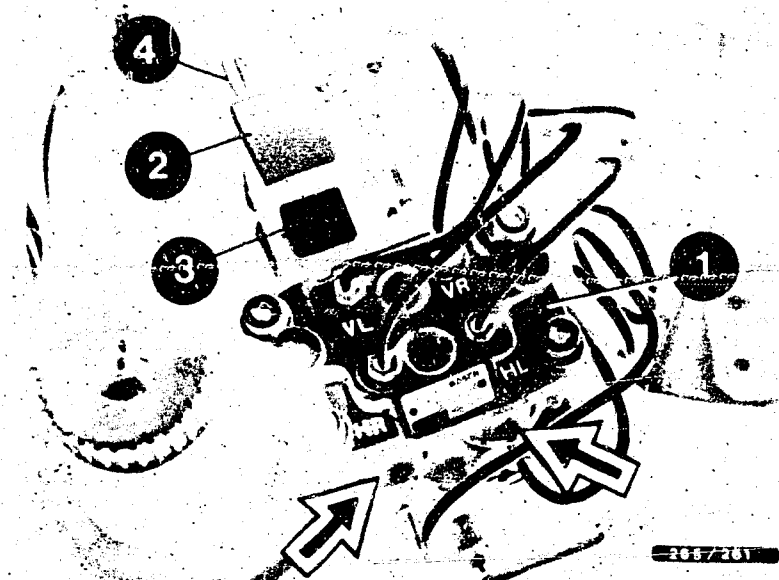
After loosening, the brake circuits can never be sealed again.

Danger to life!

- * Make visual examination for leaks in hydraulic modulator and brake-line connections.

Pay particular attention to the sealing points indicated by arrows (upper illustration).

If brake fluid is escaping, tighten (12...16 Nm) or replace the brake-line connections, or replace the hydraulic modulator.



- 1 = Hydraulic modulator
- 2 = Motor relay
- 3 = Valve relay
- 4 = Ground cable
- Arrows = Sealing points

At the base of the hydraulic modulator is a ventilation bore to the pump plunger.

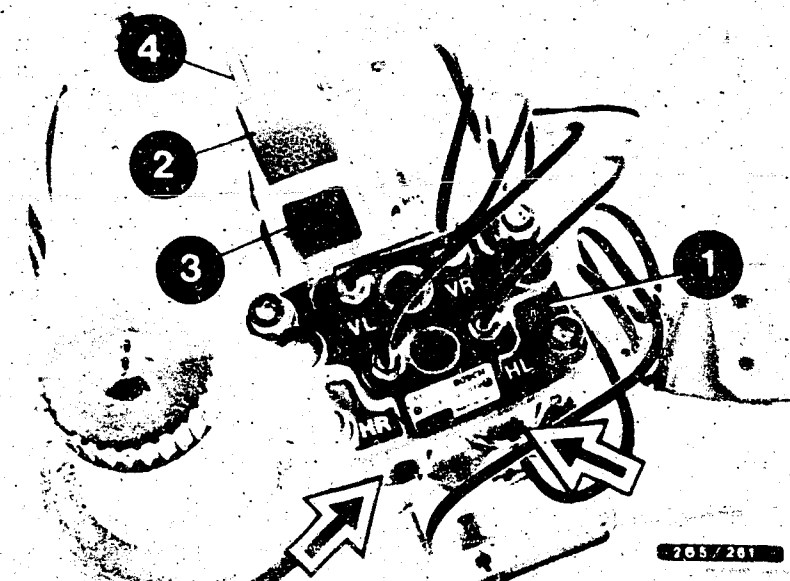
Slight escaping of brake fluid may occur at this point.

A claim is justified only if a puddle of brake fluid forms beneath the hydraulic modulator after repeated actuation of the brake pedal.

* When removing and installing the brake lines, take care that the lines are re-connected correctly assigned, in accordance with the coding at the hydraulic modulator (e.g. "VL" of hydraulic modulator must be connected to the wheel brake cylinder, front left).

* Coding at hydraulic modulator:

VL = Connection for brake line, front left	(wheel brake cylinder)
VR = Connection for brake line, front right	(wheel brake cylinder)
HL = Connection for brake line, rear left	(wheel brake cylinder)
HR = Connection for brake line, rear right	(wheel brake cylinder)



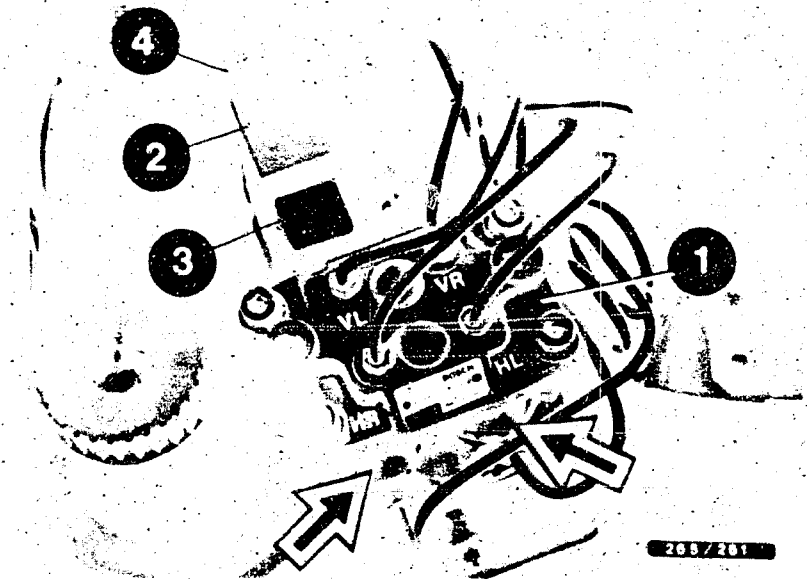
1	= Hydraulic modulator
2	= Motor relay
3	= Valve relay
4	= Ground cable
Arrows	= Sealing points

TEST STEP 5 (CONTINUED) (TEST SPECIFICATIONS AND OPERATING INSTRUCTIONS)

- * Use only the specified double-head box wrench 9 x 11 mm for loosening and tightening the brake lines.
- * Code brake lines and loosen from hydraulic modulator.
- * Catch brake fluid and avoid contact with skin, clothing or paintwork!
- * Seal brake lines and connections immediately with dummy plugs.
- * Disconnect ground cable at pump motor.
- * Loosen fastening screw and remove cap.
- * Loosen hoop and remove plug.
- * Loosen hexagon nuts of bracket and remove hydraulic modulator.

Installation

- * Position hydraulic modulator into bracket and tighten with the hexagon nuts.
- * Connect ground cable to pump motor. Connect 13-pin plug and fasten with the hoop.
- * Tighten cap with screw on the hydraulic modulator.
- * Connect brake lines to hydraulic modulator according to coding.
- * Pay attention to tightening torque for brake-line connections at hydraulic modulator: 12...16 Nm.
- * Bleed brake system and check for leaks.
- * Thoroughly check ABS with tester.



- 1 = Hydraulic modulator
- 2 = Motor relay
- 3 = Valve relay
- 4 = Ground cable
- Arrows = Sealing points

Component/Operation:

Check operation and for mix-up of wheel-speed sensors.

Note:

Check each wheel separately in turn.

* Operation: Position:
Program switch 6

* Operation in vehicle and at tester:

Chock up vehicle.
Ignition on.

The wheel to be tested must be freely turnable by hand. When testing the driven axle, the wheel not being tested must be locked.

Set switch for wheel selection to wheel to be tested (upper illustration).

Turn wheel by hand until LED 2 above the instrument lights up without flickering.
(Wheel speed approx. 1 revolution/second).

N>

Trouble-shooting:

1. LED (lower illustration) does not light up:

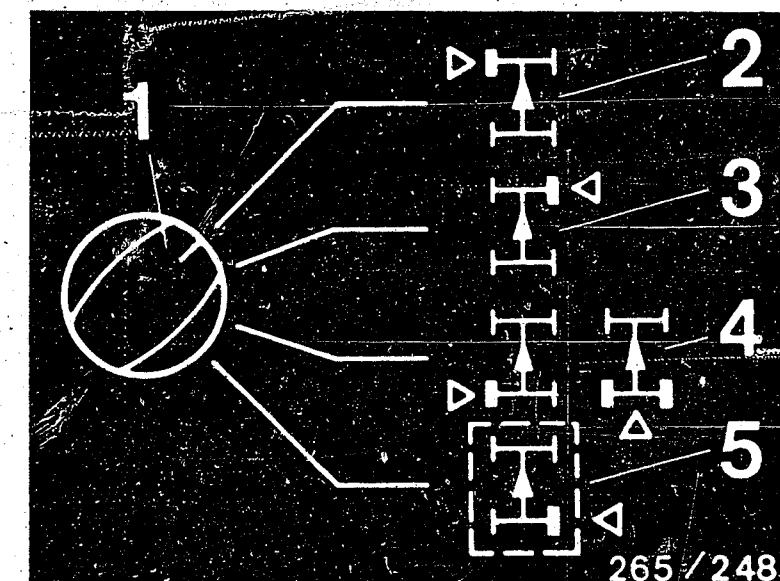
- * Wheel speed too low or too high.
- * Drive speed of wheel too low or too high.
- * Ring gear with incorrect number of teeth or ring gear missing or loose.

Number of teeth:
48 teeth per wheel.

2. Lighting up of LEDs and instrument indicators in incorrect switch position:

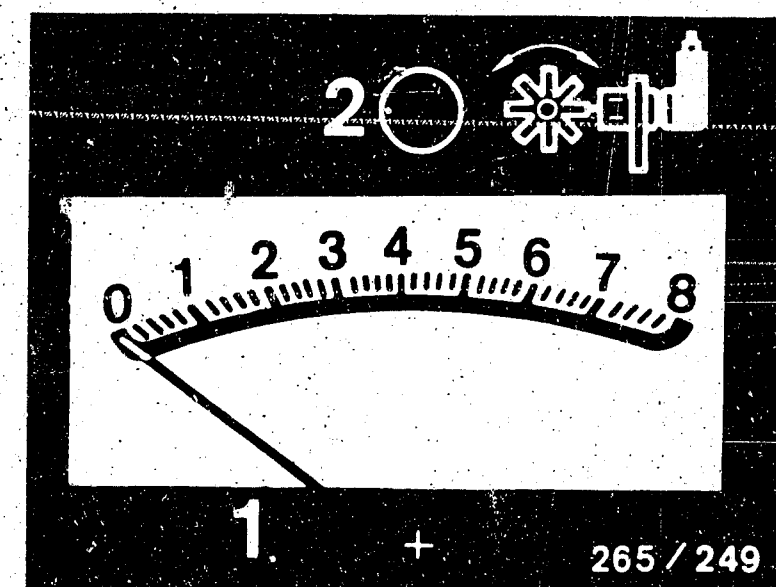
- * Plug connections of wheel-speed sensors mixed up.
- * Leads at plug K1 incorrectly connected:

Check terminal assignment in accordance with terminal diagram.



- 1 = Wheel-selection switch
2 = Wheel, front left
3 = Wheel, front right
4 = Wheel, rear left or rear axle
5 = Wheel, rear right

- 1 = Instrument
2 = LED for wheel speed



Continued on next coordinate

Continued on next coordinate

Then read off reading at instrument.

Test specification (reading).

- * Smallest reading = larger 1,6 divisions.
- * Permissible fluctuation max. 25 % of greatest reading.

Take for a road test for final check.

Warning lamp must go out with engine running.

Drive at at least 30 km/h. Warning lamp must not light up again.

If no fault can be found with the LED tester, check for loose contacts or rubbed locations in the leads, or exchange controller.

Ignition off.

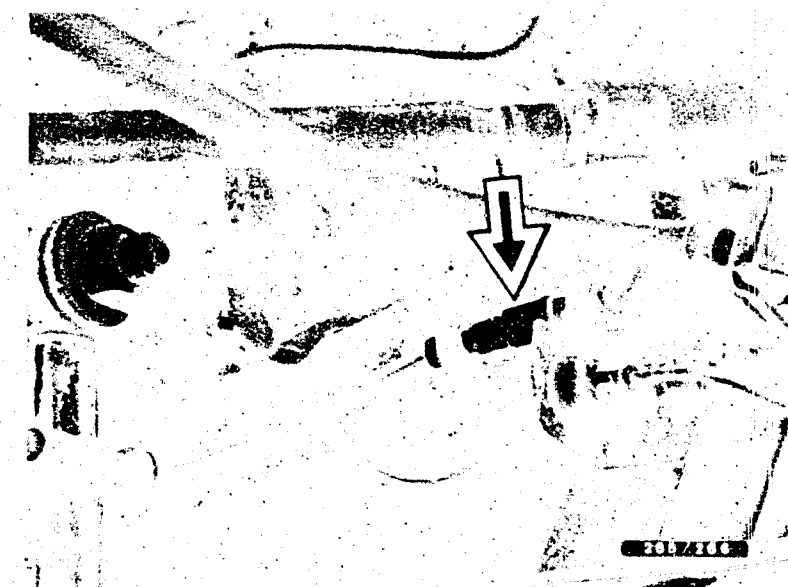
3. No instrument reading:

- * Check wheel-speed sensor for short circuit. Disconnect plug connection and measure winding resistance with ohmmeter:

Test specification: 0,6...1,6k Ω

Check for short circuit in the following wheel-speed sensor leads:

- * Wheel, front left: from controller plug K1/term.5 and term.4 to plug connection K11.
- * Wheel, front right: from controller plug K1/term.11 and term.21 to plug connection K13.
- * Wheel, rear left: from controller plug K1/term.7 and term.9 to plug connection K15.
- * Wheel, rear right: from controller plug K1/term.24 and term.26 to plug connection K17.



Arrow = Wheel-speed-sensor plug connection, front right



Arrow = Wheel-speed-sensor plug connection rear left

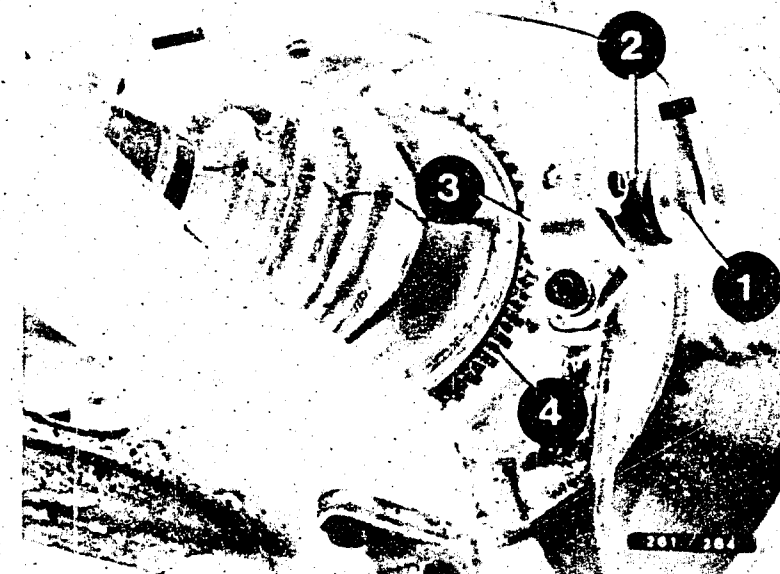
Continued on next coordinate

4. Instrument reading smaller than 1,6:

- * Air gap between wheel-speed sensor and ring gear too wide: nominal dimension 0,8 mm
- * Ring gear defective or loose or with incorrect number of teeth: 48 teeth per wheel.
- * Wheel-speed sensor defective: exchange.

5. Fluctuation too great:

- * Wheel-bearing clearance too large.
- * Ring gear defective.
- * Oval ring gear.



- 1 = Wheel-speed sensor, front axle
- 2 = Fastening screw
- 3 = Mounting
- 4 = Ring gear

Arrow = Wheel-speed sensor, rear axle



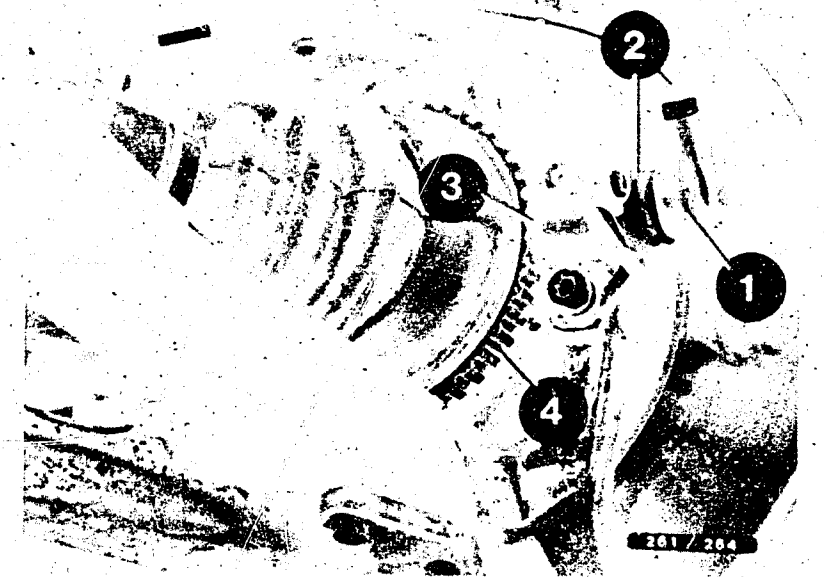
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Removing wheel-speed sensor:

- * The plug connections for the front axle are on the respective frame side member and for the rear axle on the vehicle chassis (see lower illustration).
- * Remove plug connection from clip and disconnect.
- * Loosen fastening screw for wheel-speed sensor and carefully remove wheel-speed sensor.
Do not use force.
Caution with front axle: do not unscrew mounting.
Note for rear axle: to assist removal, unbolt wheel.

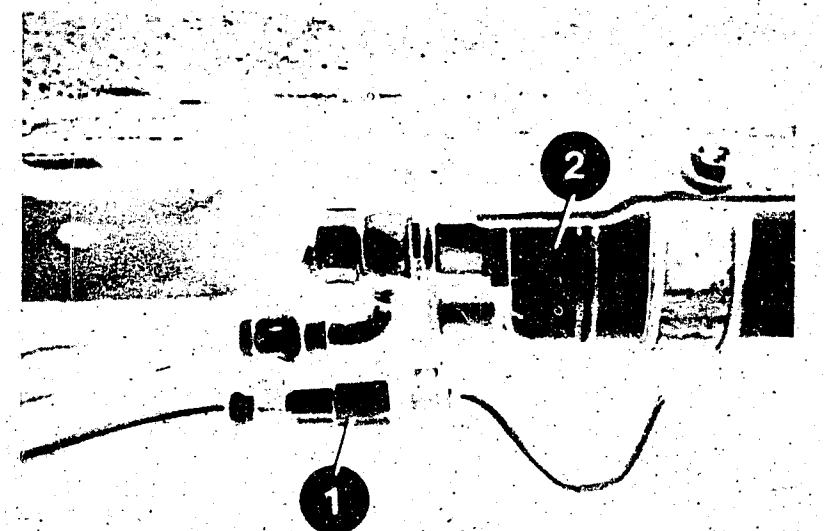
Installing wheel-speed sensor:

- * Check for cracks in O-ring and replace if necessary.
- * Only remove new wheel-speed sensor from protective wrapping for installation..
- * Lubricate wheel-speed-sensor housing with small amount of Molykote Longterm 2 lubricant.
- * Take care that there are no metallic foreign bodies on the permanent-magnetic cutter.
- * Carefully push wheel-speed sensor into mounting bore up to stop:
do not hit!
- * Use new micro-encapsulated fastening screws. Tighten fastening screws to at least 8 Nm.
- * Re-fasten lead at locations provided.
- * Connect wheel-speed sensor to ABS wiring harness and clip plug connection into clip.
- * After repair, check with LED tester.



- 1 = Wheel-speed sensor, front axle
- 2 = Fastening screw
- 3 = Mounting
- 4 = Ring gear

- 1 = Wheel-speed-sensor plug connection, rear right
- 2 = Fuel pump



INDEX OF PASSENGER-CAR ABS SERVICE CENTERS INSIDE AND OUTSIDE GERMANY

13...39|
VDT-I-265/101 En
08.1984

supersedes Ed. 04.1983

The below-listed firms meet the requirements
for performing after-sales service on
BOSCH PASSENGER-CAR ABS systems 2 and 2 B
and have the necessary service equipment.

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8900 Augsburg

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Division KH
Technical After-Sales Service (KH/VKD 2)

Please direct questions and comments
concerning the contents to our authorized
representative in your country.

REPAIR PROHIBITION / MAXIMUM ALLOWABLE STORAGE TIME FOR ABS HYDRAULIC MODULATORS

13....39
VDT-I-265/102 En
1.1986

Replaces edition of 7.1984

1. Repair prohibition

ABS for passenger vehicles is a safety system.

Unauthorized tampering with ABS components brings with it the danger of impairment of the proper functioning of the ABS system.

- # For reasons of safety, therefore, the
- # hydraulic modulator may under no circum-
- # stances be repaired, but instead must be
- # exchanged as a complete unit.

Only the engine and valve relays may be exchanged.

No other screws or plugs may be loosened or removed.

2. Maximum allowable storage time

The maximum allowable storage time for hydraulic modulators is 5 years from the date of manufacture (FD) specified on the product.

This requires that the following storage conditions be fulfilled:

- Hydraulic modulator filled with brake fluid (supplied in filled condition).
- Vertical/upright position (hood on top).
- Ambient temperature between -20°C and +50°C.
- Dry storage.

After 5 years storage time, all rubber and plastic parts must be replaced and the hydraulic modulator must be subjected to a functional test.

The replacement of rubber and plastic parts and the functional test can be carried out only at the place of manufacture. After testing, the hydraulic modulators are marked with L and a new date of manufacture (FD).

Service workshops in the Federal Republic of Germany should send the hydraulic modulators to:

Robert Bosch GmbH Abt. K1/VAK 2,
Robert-Bosch-Straße, 7141 Schwieberdingen.

Service workshops in other countries are requested to send the hydraulic modulators to:

Robert Bosch GmbH, KH/LAV 2 - Auspackraum,
z.W. an K1/VAK 2, Auf der Breit 4,
D-7500 Karlsruhe 41
West Germany.

The hydraulic modulators should be sent to us pre-paid. Please refer to this Technical Bulletin on the enclosed delivery ticket.

A fee is charged for parts replacement and functional testing.

Responsible:

ROBERT BOSCH GMBH

Division KH

Technical After-Sales Service (KH/VKD 2)

Please address questions and comments concerning the contents to our authorized representative in your country.

TABLE OF CONTENTS

<u>Section</u>	<u>Coordinates</u>
Structure of microcard.....	A01
Special features.....	A02
Test specifications/Test requirements.....	A03-A04
Rapid diagnosis chart with LED tester.....	A05-A16
Electrical terminal diagram.....	A17-A18
Test equipment and tools.....	A19-A20
Installation position of components.....	A21-A25
General information.....	A26-A28

TROUBLE-SHOOTING:

Checking ABS warning lamp.....	B01-B03
Operating ABS 2 LED tester.....	B04-B06
Test requirements.....	B07-B11
Detailed test chart to ABS tester.....	C01-D22
Technical Bulletins and	
Service Informations.....	N01-N10

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